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ACTIVITY-BASED COST AND REVENUE MODEL FOR RDT&E RATED SERVICE ACCOUNT LABORATORIES AT NAWCAD

by

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June, 1999

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This thesis adapted an Activity-Based Costing (ABC) model for the Research, Development, Test and Evaluation (RDT&E) Rated Service Account (RSA) laboratories at the Naval Air Warfare Center Aircraft Division (NAWCAD). The recent efforts to improve overall cost efficiency of Department of Defense (DOD) RDT&E laboratories has been limited by the lack of credible and comparable cost data. ABC systems have been recognized as a way to better identify what activities are performed to produce a product or service and the resource costs they consume. The CAM-I ABC model was adapted with a nine-step methodology that is user friendly and effective. The adapted ABC model was applied to a RDT&E laboratory at NAWCAD, using survey data, to demonstrate how laboratory personnel could identify their laboratory's activities and estimate their resource costs. The activity cost model provided with information for laboratory managers resource management decisions, a tool for more accurate pricing of customers' products through stabilized rates, and the cost element needed to measure laboratory performance and benchmark laboratory activities.

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ACTIVITY-BASED COST AND REVENUE MODEL FOR RDT&E RATED SERVICE ACCOUNT LABORATORIES AT NAWCAD

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ABSTRACT

This thesis adapted an Activity-Based Costing (ABC) model for the Research, Development, Test and Evaluation (RDT&E) Rated Service Account (RSA) laboratories at the Naval Air Warfare Center Aircraft Division (NAWCAD). The recent efforts to improve overall cost efficiency of Department of Defense (DOD) RDT&E laboratories has been limited by the lack of credible and comparable cost data. ABC systems have been recognized as a way to better identify what activities are performed to produce a product or service and the resource costs they consume. The CAM-I ABC model was adapted with a nine-step methodology that is user friendly and effective. The adapted ABC model was applied to a RDT&E laboratory at NAWCAD, using survey data, to demonstrate how laboratory personnel could identify their laboratory's activities and estimate their resource costs. The activity cost model provided with information for laboratory managers resource management decisions, a tool for more accurate pricing of customers' products through stabilized rates, and the cost element needed to measure laboratory performance and benchmark laboratory activities.

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I. INTRODUCTION

A. BACKGROUND

In a time of shrinking defense budgets, the Research, Development, Test and Evaluation (RDT&E) funding is expected to decline about fourteen percent between fiscal years 1997 and 2002. (GAO, 1998) The reduction in available RDT&E funding has prompted Department of Defense (DOD) RDT&E activities to rethink how their organizations are structured and how they identify their infrastructure costs. (GAO, 1998) They have also been induced to question how they accomplish their mission of introducing new technology and weapon systems to the warfighter. (Gansler, 1999) The Defense Authorization Act for fiscal year 1996 directed the Secretary of Defense (SECDEF) to develop a plan for the consolidation and restructuring of DOD RDT&E activities by fiscal year 2005. The Secretary of Defense responded with the initiative *Vision 21: The Plan for 21st Century Laboratories and Test and Evaluation Center of the Department of Defense,* which focused on implementing three objectives: 1. Reduction of underused facilities and activities that duplicate effort; 2. Restructuring activities through intra-service and cross-service consolidation; and 3. Revitalization to attain a modern, efficient, and effective laboratory and T&E center environment with a focus on the costs of facilities and infrastructure. (Cohen, 1997) Accurate cost information is a critical element to successfully achieving these objectives, as witnessed by the following statement from the Under Secretary of Defense, Acquisition and Technology (USD A&T):

> Efforts to improve the overall cost efficiency of defense laboratories and test centers have been significantly limited by the

> pervasive absence of accurate credible and comparable cost data. Current financial information available to RDT&E management is organized according to the budget and financial control process, a paradigm that emphasizes level of effort funding and "management to budget" instead of cost control. In addition, the limited cost data that are available for management review are not generally comparable across organizations due to the inconsistent financial methodologies and approaches used by the various activities and services. (Memorandum, (i),1997)

Coinciding with the *Vision 21* objectives, DOD has changed the way RDT&E organizations are funded. They have been shifted from receiving appropriated funding to being primarily funded by Working Capital Funds (WCF).

1. Navy Working Capital Fund

DON RDT&E activities are now funded through the introduction of Navy Working Capital Fund (NWCF). A NWCF activity receives its revenues from reimbursements by customers for products and services. RDT&E activities must now collect revenues using a comprehensive laboratory rate that accounts for all direct and overhead expenses. The RDT&E NWCF activity's primary annual fiscal goal is to have revenues equal expenses, achieving a Net Operating Result (NOR) of zero. All costs will be recovered over time by monitoring the NOR

Under NWCF, costs have become more visible, and the full causal relationship between laboratory activities and costs is not totally captured by the current accounting systems. Aligned with the principles of NWCF full cost recovery, Naval Air Warfare Center Aircraft Division (NAWCAD) has established a financial tool for individual laboratories called Rated Service Accounts (RSA). A RSA establishes a laboratory as an individual cost center that develops rates based on full cost recovery at their laboratory level.

NAWCAD recognizes the need for improved cost information for their laboratories as they try to become leaner and more efficient. This thesis uses Activity-Based Costing (ABC) to develop a model that can provide more accurate product and service cost information for use by a RSA laboratory.

B. OBJECTIVE

The primary objective of this thesis is to address NAWCAD's need for better cost information by developing a cost and revenue model for use by the RSA laboratories at NAWCAD. The research objective is to apply the best accounting practices to the RSA laboratories. The goal of the cost and revenue model is to provide the RSA laboratory manager an image of what costs increase or decrease as laboratory output goes up or down. Identifying laboratory costs, by defining cause and effect relationships, will help provide NAWCAD better cost information when making resource allocation decisions.

C. RESEARCH QUESTIONS

The following questions will be addressed:

1. Primary:

Can we develop a cost and revenue model that is user friendly and will provide more accurate cost information than provided by the current accounting system for NAWCAD RDT&E laboratories that have Rated Service Accounts?

2. Secondary:

What are the benefits of improving the accuracy of the cost information provided to the RSA laboratory?

Is there a need for better cost and revenue information for the RSA laboratory?

Can the model developed be used to calculate stabilized RSA rates?

Does the current cost allocation system at NAWCAD provide laboratory managers the cost visibility and incentive to frugally use overhead resources?

How can we identify what costs an RSA laboratory incurs when providing products or services to a specific customer?

D. SCOPE OF THESIS

This thesis develops a cost and revenue model to help the RSA laboratories at NAWCAD better identify costs. The cost and revenue model was developed using Activity-Based Costing (ABC) principles. The ABC model was applied at an individual RSA laboratory, by surveying a sample of the laboratory's personnel.

E. METHODOLOGY

The methodology used for this thesis was divided into the following steps: 1. Review of the financial system at NAWCAD; 2. Discussion of modern cost management models and initiatives; 3. Determination of an appropriate accounting model; 4. Adaptation of the model; 5. Application of the model; and 6. Analysis of model effectiveness and benefits.

(1.) Financial System: The author reviewed the way NAWCAD allocated and recovered expenses under the guidelines of the Navy Working Capital Fund (NWCF). Two financial challenges are also identified.

(2.) Modern Cost Management Models and Initiatives: The author reviewed modern cost management models, the need for accurate cost data in the government and cost management initiatives that DOD has attempted.

3.) Cost Allocation Model: An activity-based cost model was selected for its simplicity and opportunity to be user friendly. The model was adapted for specific application to the RDT&E laboratories at NAWCAD.

(4.) Model Adaptation: The ABC model was adapted for a RDT&E laboratory after reviewing ABC literature, and interviewing ABC consulting experts, and RDT&E laboratory and financial managers at NAWCAD. The model's adaptation is presented as a nine-step methodology.

(5.) Model Application: The ABC model was applied at NAWCAD based on survey data. A sample of twelve RDT&E laboratory personnel provided an activity-based analysis of their normal work effort. The survey data results were presented as an example of how the ABC model could be applied. Assumptions were made about both direct and indirect costs, in order to build a comprehensive model application. Time and cost limitations made it essential for assumptions to be made on how indirect costs are incurred in an RDT&E laboratory at NAWCAD.

(6.) Analysis: The evaluation of the research results emphasizes the level of effectiveness of activity-based methodology in a RDT&E laboratory.

II. NAWCAD RDT&E ORGANIZATION

A. HISTORY AND BUSINESS DESCRIPTION

1. History

Naval Air Warfare Center Aircraft Division (NAWCAD) is headquartered in Patuxent River, Maryland and is a component of Naval Air Systems Command (NAVAIRSYSCOM). NAWCAD was created under the 1991 Base Realignment and Closure (BRAC) Commission, which resulted in the realignment of five field activities in Indianapolis, Indiana; Warminster, Pennsylvania; Lakehurst, New Jersey; Trenton, New Jersey; and Patuxent River, Maryland. In 1995, the Training Systems Division in Orlando, Florida was also realigned under NAWCAD. The facilities at Warminster and Trenton have been relocated to Patuxent River, and the facility at Indianapolis has been privatized and is no longer part of NAWCAD. (Dyer, 1999) This thesis will focus on the laboratories located at the consolidated facilities of Patuxent River.

2. Business Description

NAWCAD is the Navy's full spectrum research, development, test and evaluation (RDT&E), engineering, and fleet support center for air platforms. It is a diverse RDT&E organization that is home to a unique blend of engineering personnel, facilities and aircraft. NAWCAD's workforce consists of 11,400 employees, which is composed of 1,300 military, 4,100 civil servants and 6,000 contractor personnel. (Zalesak, 1996) Their product areas include aircraft systems technology, propulsion, flight test and engineering, avionics design and production, and aircraft-platform interface. NAWCAD

works to reduce acquisition program development risks by selectively prototyping high-risk technical features and functions to verify and validate data packages and provide operational expertise to support follow-on volume production. (Dyer, 1999)

NAWCAD has primary RDT&E responsibility, as directed by the Secretary of the Navy, for the aircraft, engine, avionics and aircraft support systems listed in Table 2.1.

NAWCAD Responsibility Areas
1. Aircraft launch and recovery systems
2. Aviation support equipment
3. Propulsion system testing
4. Electronics manufacturing and production support
5. Electronics systems transition to production
6. Pilot/emergency production
7. Aircraft testing
8. Aircraft testing and evaluation (T&E) ranges
9. Aircraft modeling and analysis
10. Air vehicles, manned and unmanned
11. Aircrew equipment and life support
12. Airborne surveillance systems
13. Air antisubmarine warfare systems and sensors
14. Aircraft electronic warfare test and evaluation
15. Air platform systems integration
16. Aircraft active and passive signatures
17. Air vehicles propulsion

Table 2.1 NAWCAD Leadership Areas (Dyer, 1999)

The products that result from these responsibility areas include: system specifications, production data packages, integrated logistics plans, formulation of

contracts, training programs, and test plans. NAWCAD's primary customers are the program offices from NAVAIR, which are also located at Patuxent River. NAWCAD has other federal customers that include Naval Research Lab (NRL), Air Force F-16, Army OH-58D/AH-64D, and the National Highway and Traffic Safety Administration (NHTSA) among others. NAWCAD also has worked to build a commercial customer base, which includes companies such as Sikorsky Helicopters, Meggitt Corporation and Boeing Aerospace. (Dyer, 1999)

B. COMPETENCIES

In October 1994, NAWCAD converted into a Competency Aligned Organization (CAO) to become a more cohesive, team-oriented, and flexible organization in the changing defense acquisition environment. NAWCAD maintains that CAO has improved competitiveness, enhanced project execution, improve value to their customers, improved quality and efficiency, and incorporated continuous improvement throughout the organization. (Dyer, 1999) Under CAO, NAWCAD has been structured into eight competencies shown in Figure 2.1.

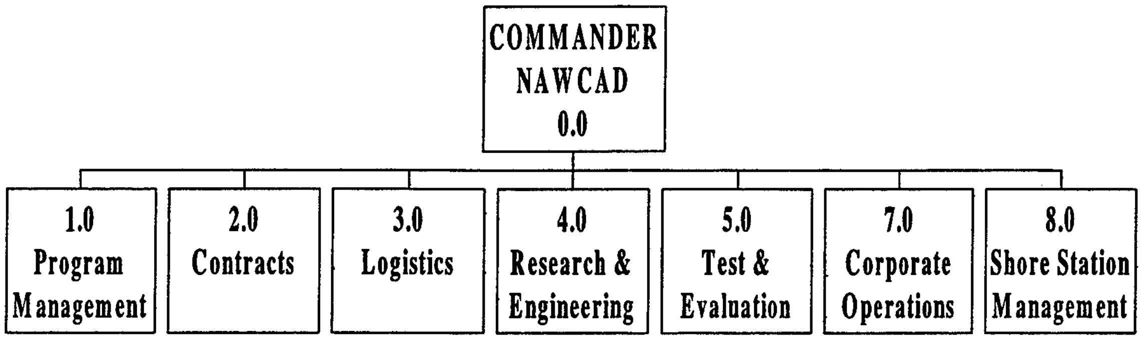

Figure 2.1 NAWCAD Organization Chart

The eight competencies are divided into two categories: 1. revenue generating competencies and 2. cost generating competencies. Competencies 1.0 Program Management, 3.0 Logistics, 4.0 Research and Engineering, and 5.0 Test and Evaluation, are revenue-generating competencies because they provide a product or service to an external customer and receive compensation. The cost generating competencies, 0.0 Headquarters, 2.0 Contracts, 7.0 Corporate Operations, and 8.0 Shore Station Management, provide products or services to internal NAWCAD organization and therefore do not generate outside revenue. The costs incurred by these competencies are classified as overhead and are paid for by the revenue generated by competencies. This thesis will focus on the laboratories that are located in competencies 4.0 Research and Engineering, and 5.0 Test and Evaluation, the largest revenue generators at NAWCAD. (Wernecke, 1998)

1. Competency 4.0 Research and Engineering

Competency 4.0, research and engineering, was established to perform research and engineering for naval aviation systems. Their primary focus is on research and

development of aviation system acquisition, technology development and product support. There are twelve departments in competency 4.0, with department 4.0 serving as the headquarters for the entire competency. The remaining departments are designed to service a particular aviation system (i.e., propulsion and power). The organizational structure for competency 4.0 is displayed in Figure 2.2.

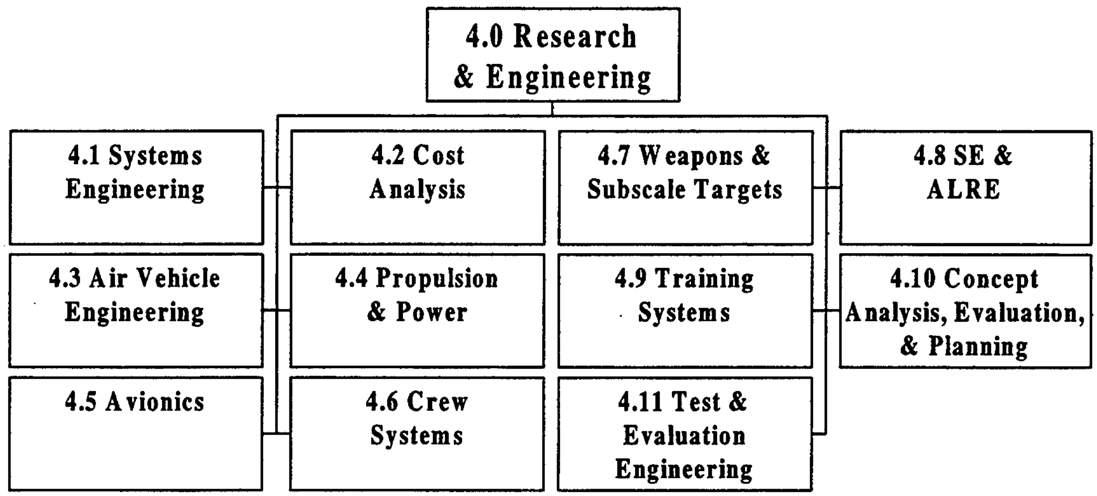

Figure 2.2 Competency 4.0 Organization Chart

2. Competency 5.0 Test and Evaluation

Competency 5.0, test and evaluation, provides cutting edge test, evaluation and training products and services for aviation related customers. Competency 5.0 provides a multitude of products and services; its facilities vary from an open test range to a controlled laboratory environment. There are four departments in 5.0, with department 5.0 serving as the headquarters for the entire competency. The other three departments are large and each has a diverse mix of divisions within their department. The organizational structure for competency 5.0 is displayed in Figure 2.3.

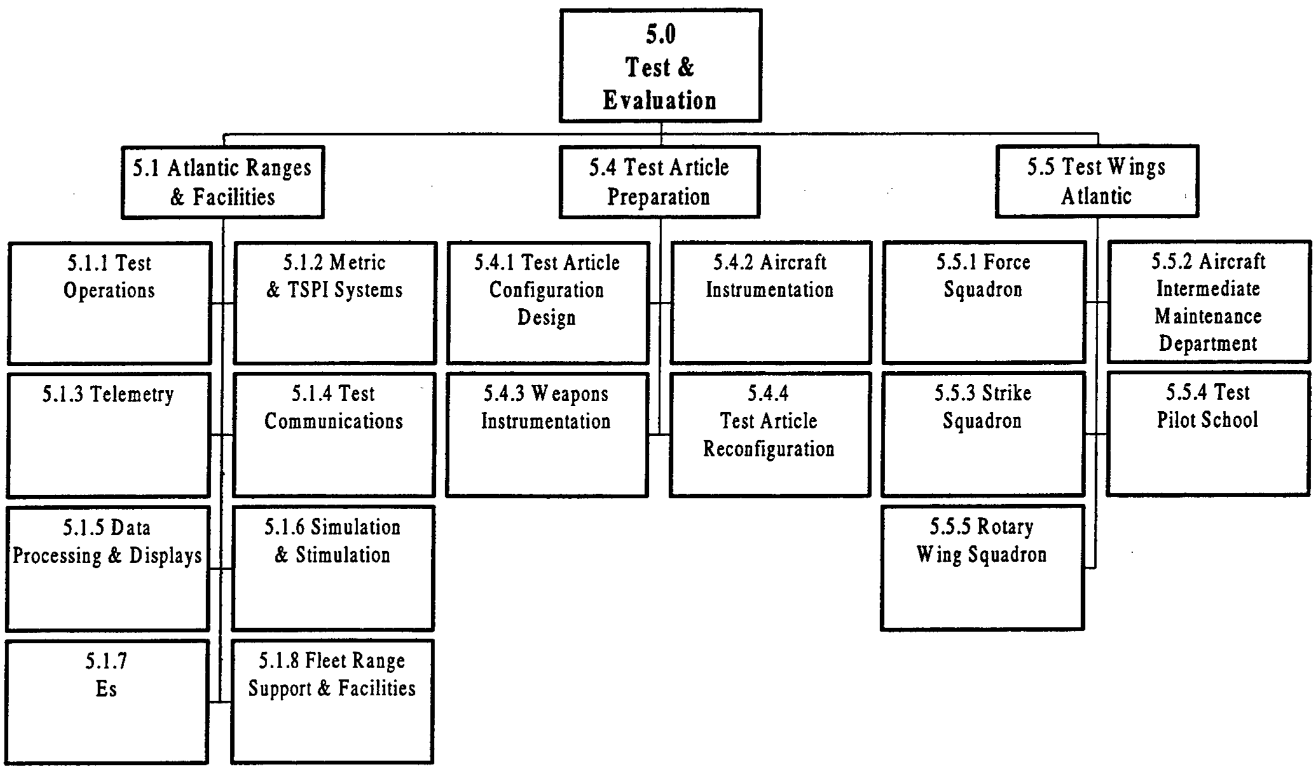

Figure 2.3 Competency 5.0 Organization Chart

C. COMPETENCY 4.0 AND 5.0 INFRASTRUCTURE

Competency 4.0 and 5.0 are responsible for the laboratory and test facility infrastructure at NAWCAD, Patuxent River, Maryland. Over 500 competency 4.0 and

5.0 laboratories and test facilities are housed at NAWCAD. These laboratories are operated to provide two capabilities: research and development capability, and test and evaluation capability.

1. Research and Development Infrastucture (Competency 4.0)

There are a myriad of activities that occur in the research and development facilities at NAWCAD. A description of the major research and development facilities and their capabilities are listed in NAWCAD's corporate business brief and have been summarized below:

North Engineering Center- It is a 255,000 square foot facility that houses hardware integration centers and software production facilities for maritime surveillance aircraft. Enclosed in the facility is a large acoustic sensor laboratory, which is used for the development of new ASW sensors. (Zalesak, 1996)

South Engineering Center- It is a 450,000 square foot facility that houses numerous air vehicle, aircrew systems and avionics labs. The facility has supported tests and evaluation of rigid and energy-attenuating seats, ejection seats, clothing assemblies, restraints, and body-mounted equipment. (Zalesak, 1996)

Robert N. Becker Materials Laboratory- This facility provides a capability for the complete synthesis and characterization of existing and new materials concepts. Maritime environment simulation and characterization are emphasized. (Zalesak, 1996)

Vertical Accelerator- It is a facility for test and evaluation of new ejection seat technology. It is the only ejection seat facility in the U.S. that is capable of live human subject testing. (Zalesak, 1996)

Microwave Test Facility- This facility's mission is to design, develop, test and evaluate antennas, radomes, and related avionics systems for fleet aircraft. The facility has two anechoic chambers, six outdoor antenna ranges, a plastic fabrication lab used to build radomes and a one-of-kind rain-erosion test facility. (Zalesak, 1996)

Propulsion Facility- This facility's mission is propulsion testing of engine accessories and aircraft engine systems. It houses an accessory test area, helicopter transmission test area, UAV propulsion test area, fuels and lubricants test facilities, and a rotor spin facility. (Zalesak, 1996)

2. Test and Evaluation Capability (Competency 5.0)

The test and evaluation facilities at NAWCAD are used for aircraft and aircraft component testing. A description of the major test and evaluation facilities and their capabilities are listed in NAWCAD's corporate business brief and have been summarized below:

Air Field- It is an all-weather sea level airfield that has three heavy capacity runways. There are eleven hangars that provide over 1.2 million square feet of space to the 130 aircraft assigned to the naval station. (Zalesak, 1996)

Naval Test Wing Atlantic- It is the busiest flight test center in the world. Activities include flight operations performed by strike, rotary-wing, and force aircraft test squadrons and the U.S. Naval Test Pilot School. (Zalesak, 1996)

Test Article Preparation- This facility provides aircraft instrumentation and aircraft modification services. Housed in the facility is a complete metal shop and composite shop, which allows rapid prototyping of aircraft modifications. (Zalesak, 1996)

Air Combat Environment Test and Evaluation Facility (ACETEF)- It is a fully integrated ground test facilitate allowing full-spectrum test and evaluation of aircraft and aircraft systems in a secure and controlled engineering environment. (Zalesak, 1996)

Electromagnetic Environmental Effects Test and Evaluation Facilities- These facilities provide an isolated electromagnetic environment for intersystem and intrasystem testing. (Zalesak, 1996)

Aircraft Test and Evaluation Facility (ATEF)- This facility provides the capability to ground test installed aircraft propulsion, mechanical, electrical, and pneumatic subsystems in a controlled environment. (Zalesak, 1996)

Dynamic In-Flight Radar Cross Section (RCS) Measurements- This facility provides telemetry, tracking data, range control, airborne instrumentation and in-flight dynamic RCS measurements. (Zalesak, 1996)

Carrier Suitability Facilities- These facilities include steam catapults and arresting gear to determine if new or modified aircraft can survive launch and recovery cycles associated with carrier operations. (Zalesak, 1996)

III. FINANCIAL MANAGEMENT

This chapter provides an overview of the Navy Working Capital Fund (NWCF), a description of NAWCAD as a dual-funded activity (receiving both appropriated funding (direct funding) and budget authority from the NWCF), a description of NAWCAD's costs, a description of how NAWCAD determines stabilized rates, and a description of two financial challenges that NAWCAD faces.

A. NAVY WORKING CAPITAL FUND

1. History

In 1991, DOD established the Defense Business Operations Fund (DBOF) in order to create a more business-like environment for DOD depot maintenance, finance and accounting, supply and transportation activities. The DBOF consolidated the nine existing industrial and stock funds operated by the military services and DOD, into a single financial structure. (GAO, 1997) In 1996, the Under Secretary of Defense (Comptroller) divided DBOF into four separate working capital funds — Army, Navy, Air Force, and Defense-wide — called the Defense Working Capital Funds (DWCF). Under the Navy Working Capital Fund, the Navy was now responsible for managing the financial activities in its own business areas. When the NWCF was established, it also became the funding mechanism for other business areas in the Navy, which included research and development activities. (FMR, 1998)

2. Purpose

The NWCF was established in order to increase cost visibility to both the customers and providers in the Navy's business areas. The NWCF operates under the concept of a revolving fund structure, where the provider's operations are financed by collecting revenue for products and services to its customers. (FMR, 1998) The DOD Financial Management Regulation (FMR) describes the purpose of a revolving fund:

> The basic tenet of the revolving fund structure is to create a customer-provider relationship between military operating units and support organizations. This relationship is designed to make managers of support organizations funded through Working Capital Fund (WCF) and decision-makers at all levels more concerned with the costs of goods and services. Requiring the operating forces to pay for support they receive provides increased assurance that services supplied and paid for are actually needed. (FMR, 9-1,1998)

NAWCAD is operated and financed primarily as a NWCF activity. (NAWCAD, 1998) They are dependent on their customers for their financial survival; therefore, they have the incentive to provide the products and services at the lowest possible costs.

3. Budgets

Each NWCF activity formulates two budgets when preparing their biennial Budget Estimate Submission (BES). They formulate a capital budget, which accounts for capital investments, and an operating budget, which accounts for annual operating costs. The capital budget is used to purchase depreciable property, plant, equipment, and software developed, manufactured, transferred or acquired during a fiscal year for a determinable cost of $100,000 or more and that has a useful life of two years or greater. The operating budget contains all annual operating expenses, which includes direct costs, indirect costs and capital equipment depreciation expenses. (FMR, 1998)

4. Full Cost Recovery

The NWCF activity's goals are to generate enough revenues to recover all operating expenses and operate on a break-even basis. The goal of breaking-even is referred to as achieving an Accumulated Operating Result (AOR) of zero over the long-term operation of the NWCF activity. A NWCF activity works towards an AOR of zero by monitoring the Net Operating Result (NOR), which is the difference between revenues and expenses during the current fiscal year. The NWCF activities recover all costs by billing their customers with a stabilized rate. Stabilized rates reflect full costs, which include direct costs, indirect costs, general and administrative costs, and any gains or losses, from prior years, as determined by the AOR. The NAWCAD stabilized composite rate (for the entire organization) that was submitted for the FY 00 Presidential Budget is listed in Figure 3.1.

Direct Labor Rate	$43.91
Indirect Cost Rate	$10.65
General & Administrative Rate	+ $28.20
Total Rate	$82.76
AOR Recoupment	+ $0.37
Composite Rate	$83.13

Figure 3.1 NAWCAD FY 00 Stabilized Composite Rate

Stabilized rates are established prior to the upcoming fiscal year and remain fixed during the fiscal year. This allows customers to formulate their budgets and purchase the products and services from the NWCF activity as they were budgeted.

5. Activity Groups

A NWCF activity is categorized into one of two activity groups (for stabilized rate setting purposes):

1. Supply Management Activity groups – Use commodity costs in conjunction with a surcharge to establish customer rates. (FMR, 1998)
2. Non-Supply Management Activity groups – Depot Maintenance, Research and Development, Transportation, Distribution Depots, Base Support, and all other activity groups that have unit cost rates established based on identified output measures or representative outputs. These output measures establish fully cost burdened rates per output, such as cost per direct labor hour, cost per product, cost per item received cost per item shipped, etc. (FMR, 1998)

The Supply Management Activity group attaches a cost recovery factor (surcharge) to supply items that are requisitioned by customers. The cost recovery factor is a stabilized percentage increase to what the customer pays for supply items. The cost recovery factor is used to recover the following Supply Activity Management group costs: cost of supply of operations, transportation, inventory losses, obsolescence, price stabilization/inflation, and inventory maintenance.

NAWCAD is a Non-Supply Management Activity, so therefore it must develop a stabilized rate based on a burdened output unit cost. Determining expenses, to calculate a stabilized rate, is accomplished by projecting NAWCAD's workload for the upcoming fiscal year. Therefore, it is essential that customers provide accurate forecasted demand information and that NAWCAD maintains costs within unit cost goals.

NAWCAD is not completely funded by the NWCF. NAWCAD is a dual funded activity because it receives some appropriated funding that covers overhead costs and capital investments for its mission funded areas. The amount of appropriated funding regularly makes up approximately 20 percent of NAWCAD's total fiscal year budget for FY 99. (NAWCAD, 1999) The appropriated funding that NAWCAD receives, supports the following: Major Range Test Facility Base (MRTFB), Base Realignment and Consolidation (BRAC), Engineering and Scientists Development Program (ESDP) and Base Operating Support (BOS). (NAWCAD Business Brief, 1998)

B. IDENTIFYING EXPENSES

NAWCAD's fiscal goal is to have their revenues, generated by providing products and services to external customers, equal their total expenses at the end of the fiscal year. NAWCAD relies on close communication with its customers to plan the workload for the upcoming fiscal year, which in turn affects predicted expenses. NAWCAD has direct costs and overhead expenses like any large organization. The overhead expenses are broken down into two categories: production overhead and general and administrative costs.

1. Direct Costs

NAWCAD defines direct costs as, "All such costs that can with reasonable effort, be identified consistently and uniformly to specific customer/user program." (NAWCAD Business Brief, 1998) The largest portion of direct cost is the direct labor cost, which consists mainly of the salaries for engineers and technicians working directly on a specific

program. Other direct costs that are easily identifiable are customer program specific material, travel, training and construction costs.

2. Production Overhead

NAWCAD defines production overhead as:

> Expenses incurred by direct cost centers that cannot be readily nor necessarily identified to a specific customer order (i.e., office equipment/supplies, overhead contracts, training, travel, routine facilities maintenance and maintenance of equipment. (NAWCAD Business Brief, pg. 19, 1998)

Direct cost centers are the revenue generating competencies (Competencies 1.0 Program Management, 3.0 Logistics, 4.0 Research and Engineering, and 5.0 Test and Evaluation) that provide products and services to external customers. Each department in the competency (i.e., 4.3 Air Vehicle, 4.4 Propulsion and Power, 4.5 Avionics) incurs production overhead expenses. The percentage distribution of competency 4.0's production overhead expenses are shown in table 3.1.

Competency 4.0 Production Overhead
(Projected for FY 1999)

Classification			%
Labor			58%
	Technicians	20%	
	Managers	19%	
	Secretaries	16%	
	Training (labor)	15%	
	Military	11%	
	Other	19%	
Contracts			18%
Materials			10%
Training			4%
Travel			3%
Awards			3%
Other			4%
Total			**100%**

Table 3.1 Competency 4.0 Production Overhead
(Source, Competency 4.0 FY 99 Budget)

The majority (58 percent), of competency 4.0's production overhead, is the labor that provides managerial, administrative and maintenance support. These personnel are not working exclusively for one customer or lab, but instead provide support services to multiple labs and customer job orders. The corporate headquarters of competency 4.0, division 4.0S, is comprised of production overhead employees. (Research & Engineering, 1999)

3. General and Administrative Overhead (G&A)

NAWCAD defines G&A expenses as:

> Costs incurred that are of an indirect nature, which support the entire activity. They cannot be identified to a direct program or production cost center. (NAWCAD Business Brief, pg. 20 1998)

G&A expenses are defined as those incurred by the general cost centers (non-revenue generating), which include competencies 0.0 Headquarters, 2.0 Contracts, 7.0 Corporate Operations, and 8.0 Shore Station Management. The direct cost centers (revenue generators), which include competencies 1.0 Program Management, 3.0 Logistics, 4.0 Research and Engineering, and 5.0 Test and Evaluation, only produce direct and production overhead costs. NAWCAD's estimated breakdown of all the components that comprise G&A are listed in Table 3.2.

NAWCAD G&A Component Breakdown

Competency	Description	%
0.0	Staff	0.54%
2.0	Staff	0.18%
2.1/2.2	Project/Competency procurement	2.41%
2.3	Small purchases and support	2.10%
7.0/7.1/7.5/	Staff/Quality management/Public affairs	1.35%
7.2	Information management	15.65%
7.3	Human resources	3.49%
7.4	Security	1.12%
7.6	Comptroller/Financial management	12.29%
7.6	Corporate (Depreciation)	18.95%
7.7	Counsel	0.58%
8.0	CO/Staff	2.15%
8.1/8.2	Admin/Supply	5.54%
8.3	Public works	25.25%
8.4	Physical security	4.56%
8.5	Air operations	0.98%
8.6/8.7	MWR/OSH	2.86%
	Total	100%

Table 3.2 NAWCAD Estimated G&A (NAWCAD Business Brief, 1998)

The following four departments generated 72 percent of the entire G&A bill: 1. Information management; 2. Comptroller; 3. Corporate management; 4. Public works. The information management department provides E-mail, computer, telephone and

business system support. The comptroller department develops and manages the budget, handles the civilian payroll and manages business system development. The corporate management department calculates equipment depreciation expenses and Defense Finance and Accounting Service (DFAS) costs. The public works department costs include utilities, major repair projects, facility maintenance, janitorial and airfield maintenance. (NAWCAD Business Brief, 1998)

The direct cost centers, competencies — 1.0 Program Management, 3.0 Logistics, 4.0 Research and Engineering, and 5.0 Test and Evaluation — have the responsibility of collecting sufficient revenue to offset the G&A expenses. The one exception is that competency 5.0 pays a ($30 million in FY 1998) portion of NAWCAD's G&A expenses through appropriated Major-Range-Test-Facility-Base (MRTFB) funding. MRTFB is appropriated funding that is intended to fund national test and evaluation assets that are deemed essential to national defense and are considered national assets. (Nash, 1999)

C. EXPENSE RECOVERY (ESTABLISHING STABILIZED RATES)

NAWCAD has established two different stabilized rates to recover expenses, a Direct Labor Hour (DLH) Rate and Rated Service Account (RSA) Rate. Each RDT&E laboratory at NAWCAD uses only one of these two stabilized rates to bill their customers. The majority of NAWCAD laboratories (70 percent) use DLH rates and they bill the customers for the amount of direct labor hours that went into producing their product or service. The laboratories that use RSA rates, do so because they cannot readily identify the direct labor costs that went into one specific customer's product or service. (NAWCAD Business Brief, 1998)

1. Direct Labor Hour (DLH) Rate

The Direct Labor Hour (DLH) rate is computed by dividing the sum of all labor, nonlabor, and material direct, indirect, general and administrative expenses projected to be incurred by the activity group during the fiscal year, by the total number of direct labor hours anticipated to be accomplished during the fiscal year. (FMR, 1998) At NAWCAD, competency 4.0's stabilized DLH rate is composed of three parts: 1. Accelerated Direct Labor Rate; 2. Production Overhead Rate; 3. G&A Overhead Rate. The Accelerated Direct Labor Rate is determined by calculating the average hourly rate for the competency, including overtime, and then accelerating (increasing) it by 46 percent to account for government leave and benefits. The production overhead rate is calculated by dividing the competency's total forecasted production overhead expenses by the total planned burdened work hours for the competency. The G&A overhead rate is calculated by subtracting the MRTFB contribution from the total predicted fiscal year G&A costs, and dividing the result by the burdened work hours for all the direct cost centers. An example of competency 4.0's stabilized DLH rate , FY 99,is listed in Figure 3.2. (NAWCAD Business Brief, 1998)

Competency 4.0 Research and Engineering Stabilized DLH Rate (FY 99)	
Average hourly rate (including overtime)	$29.75
Acceleration of labor for anticipated and government share of benefits	x 1.46
Accelerated direct labor rate	$43.44
Production overhead rate	+$10.47
G&A overhead	+$26.48
Stabilized rate	$80.39

Figure 3.2 Competency 4.0 FY 99 Stabilized DLH Rate (Harris, 1999)

Competency 5.0's DLH rate consists of only the accelerated direct labor rate, because overhead expenses are compensated by MRTFB. An important feature of a stabilized DLH rate is that it provides NAWCAD's customers price stability and makes their budget preparation and execution less complex.

2. Rated Service Accounts (RSA) Rate

Rated Services Accounts (RSA) were originally established at NAWCAD to equitably and uniformly distribute costs to customers in laboratories and test facilities where maintenance and operation costs are not readily identifiable to specific customers at the time work is performed. (NAWCAD Business Brief, 1998) Within an RSA, all costs (direct labor/material, production overhead and G&A overhead) are captured and then distributed to customers using a stabilized RSA rate based on a logical unit of measure. Typical logical units of measures are engineering hours, test planning hours, test set-up hours and test execution hours. Calculation of an RSA rate requires the laboratory manager to forecast customer base for the upcoming fiscal year and their

requirements. Fiscal year work requirements then drive the appropriate number of labor work years needed. RSAs recover their fair share of NAWCAD's G&A overhead expenses by being allocated a "G&A tax" of $50,000, FY 99, to each direct civilian work year (1,740 hrs for a civilian workyear) needed for the fiscal year's workload. (Runion, 1999) Contractor personnel contribute a smaller portion to the total overhead bill through an onsite fee allocation, which is $7,000, FY 99, for each contractor workyear. (A contractor workyear is 2,000 hrs.) (Runion, 1999) The contractor onsite fee is based on production overhead and G&A expenses that are associated with occupying space on the base, such as network communications, utilities, fire and emergency, environmental compliance and base maintenance and repair. The justification for establishing an onsite fee is discussed later in the chapter.

The RSA production overhead expenses are listed by actual costs. These production overhead expenses include travel, training and equipment maintenance. Also, for each RSA the material and supply costs that will be needed to support their customers are predicted. Those costs are also included in the total RSA cost calculation. The RSA rate is calculated for the upcoming fiscal year by dividing the total of RSA expenses by the total workload projection, which is stated in a logical unit of measure. An example of a competency 4.0 RSA cost estimation and rate calculation process is presented in Figure 3.3.

Rated Service Account

1. Lab name: Lab A
2. RSA Function: Test and analyze aircraft equipment in laboratory environment
3. Facility: Bldg. 2187 (5,605 total square feet)
4. Total number of employees:
   Civilian- 6, Military- 0, Contractor- 4
5. Maintenance and Operations cost:

Element of Expense	Maintenance Expenses	Operations Hours	Operations Expenses	Total Expenses
Civilian labor		10,440	$363,838	$363,838
Military labor		0	$0	$0
Contractor		8,000	$325,482	$325,482
Materials & Supplies	$135,800		$11,505	$147,305
Travel			$27,350	$27,350
Training			$22,230	$22,230
Onsite contractor fee			$28,000	$28,000
G&A tax			$300,000	$300,000
Total	$135,800	18,440	$1,078,405	**$1,214,205**

6. Unit of Measure: Engineering hours
7. Workload Projections:

Projected Units	Customer	Program
165	PMA-231	E-2 SBIR
245	AIR 4.6.1	JSS
435	PMA-202	JHMCS
700	PMA-202	Day/Night HMD
985	PMA-202	Adv. Display Dev.
335	AIR 4.6T	Crusader
785	VAT	Visual Arch Tech
3650 Total units		

8. Rate Calculation:
   Total M&O cost divided by total units. $1,214,205 / 3,650 = **$332.66 RSA rate**

Figure 3.3 Sample RSA Rate Calculation

A laboratory that uses a RSA rate, vice DLH rate, is operating as a mini revenue and cost pool in the larger NAWCAD revenue and cost pool, under the principles of Working Capital Fund (WCF) activity groups. An illustration of laboratories under the RSA rate and the DLH rate is provided as Table 3.3.

RSA Rate Lab			VS.	DLH Rate Lab		
Name	Logical Unit	Rate		Name	Unit	Rate
Electrical Service lab	Engineering Hour	$131.14		Material Application lab	DLH	$80.39
Horizontal Accelerator	Per Set-up	$2,362.40		Environmental Test lab	DLH	$80.39
	Per Test	$4,112.75				
	Plan Hour	$142.01				
Man Machine Inter	Set-up Hour	$321.71		Electro-optics lab	DLH	$80.39
	Test Hour	$472.48				

Table 3.3 RSA Rate Laboratory Versus DLH Rate Laboratory

A RSA is attempting to provide products and services at a rate close to actual costs by billing their customers with stabilized RSA rates based on a logical unit of measure or measures (i.e., planning hours, setup hours, and execute hours). These units of measure are basically activity rates that reflect the consumption of resources.

D. CHALLENGES

Two financial challenges that NAWCAD faces are described. Financial management at NAWCAD is a complex and challenging endeavor. The diversity of the NAWCAD organization and the obligation to balance revenues and expenses, according to NWCF guidelines, produces financial management challenges.

1. Combatting a Death Spiral

The "Death Spiral" is a term used within the NWCF to describe the effect that a shrinking customer base has on increasing the rates for the rest of the customer base. NWCF budgets are based on a forecast of an upcoming fiscal year's workload. If the workload does not materialize, there will be fewer customers and less direct labor work years available to be used to allocate overhead expenses. Fewer direct labor work years leads to increased stabilized DLH and RSA rates. As rates increase, NAWCAD customers are likely to economize and seek out alternate providers or decrease their current demand. If customer demand declines, NAWCAD will have to allocate overhead costs over even fewer work years which continues the "Death Spiral." To combat the "Death Spiral," NAWCAD tries to reduce costs in areas where workload is not sufficient or reduce infrastructure. Because NAWCAD is not a commercial RDT&E facility, it can be difficult to reduce costs because of government regulations, civil servant hiring/firing regulations, fixed military labor (short-run), and capital assets that still have to be depreciated. (Harris, 1998)

2. Burdened Rate Disparity (Government Employee vs. Contractor)

The burdened rate disparity, at NAWCAD, is the difference between the overhead cost burden shouldered by government personnel (NAWCAD civilian and military employees) and contractors. The Navy Comptroller Manual, Volume V, delineates that overhead rates will be based on civilian and military direct labor hours. (NAVCOMPT, 1-35, 1990) The Navy Comptroller must approve any deviations from this policy. In 1997, the NAVAIR Corporate Business Office (CBO), NAWC Weapons Division (NAWCWD), and NAWCAD decided to build overhead cost pools that associated cost

with benefit, using lessons learned from private industry, thereby creating a fairer and more equitable distribution of overhead costs to NAWC customers. (NAWCAD, 1998) NAWC developed three cost pools: production overhead cost pool, G&A cost pool, and a new occupancy cost pool. The occupancy cost pool is comprised of production overhead expenses and G&A expenses that can be associated with occupying space on the base. Occupancy costs were determined to be: network communications, environmental compliance, heating fuel, base maintenance and repair, occupational safety and health, network applications, depreciation, fire and emergency, network infrastructure, and utilities. The total expenses in the occupancy cost pool are then divided by all direct work years (government and contractor) for the fiscal year to establish a contractor onsite fee. The government employee share of the occupancy costs are then rolled back into the production overhead and G&A cost pools to be allocated as production and G&A overhead rates to the DLH and RSA rates, as discussed previously in this chapter (Establishing Rates). NAWCAD received permission from the Navy Comptroller office to apply the contractor onsite fee for first time in FY 99. (Runion, 1999)

The onsite fee is a step in the direction towards relating overhead to specific cost drivers. The new method does allocate a larger overhead burden to government employees than it does to contractors. For example, when calculating a stabilized RSA rate, the government employee's work year is burdened with the $50,000 G&A tax discussed previously while the contractor's work year is burdened with only a $7,000 onsite fee. (Runion, 1999) Customers using a RSA laboratory that is predominantly staffed with government employees will pay more of NAWCAD's overhead expenses than a customer who uses another RSA laboratory that is predominantly staffed with contractors, as illustrated in Table 3.4.

Contractor versus Government Personnel Burden Rate

RSA LAB A		RSA LAB B	
Workforce	Overhead Contribution	Workforce	Overhead Contribution
10 Government	$500,000	2 Government	$100,000
2 Contractors	$14,000	10 Contractors	$70,000
Total Contribution	$514,000		$170,000

- Lab A workers contribution to overhead is more than three times that of the Lab B workers

Lab A output = 1000 research units   Lab B output = 1000 research hours

Overhead rate per unit -> Lab A = $514 per unit, Lab B = $170 per unit

Table 3.4 Overhead Burden Rate Example

The difference in overhead burden may create an incentive for the RSA manager to replace government personnel with contractors. Today, the contractor workforce executes approximately one-third of the NAWC direct labor hours. Apart from any incentives created by the differences in applied overhead, the level of contractor execution is likely to increase with the DOD emphasis on commercial outsourcing. (NAWCAD, 1998)

IV. MODERN COST MANAGEMENT

Cost management is an important issue for both the Department of Defense (DOD) and commercial industry. This chapter provides a brief discussion of the cost management approaches known as Activity-Based Costing (ABC) and Activity-Based Management (ABM). The discussion includes a listing of terminology and a comparison of different views of cost systems. There is also a review of a GAO report that highlights the need for better cost management information at federal RDT&E activities. After the review, the author describes two DOD cost management initiatives and their current status.

A. ABC AND ABM

Activity-based Costing (ABC) and Activity-based Management (ABM) have gained popularity in the last ten to fifteen years. Their initial popularity has been driven by a realization in industry that in many instances the cost systems in place did not provide accurate product costs. Industry had become more and more automated which significantly decreased the ratio of direct labor and material costs to total product cost. The cost systems in place were designed for labor intensive and not capital intensive processes. A means to restructure the cost systems was needed. New cost management systems, like ABC/ABM, support an organization by providing cost information on how work is currently being performed. (Antos and Brimson, 1994)

For at least the last ten years, ABC/ABM have been a focus of cost management research and publishing. One study (Cooper, et al.,1992) describes the implementation of

ABC at eight companies with varied results. The authors identified two stages, analysis and action, that must be traversed for an organization to successfully benefit from an ABC project. They also identified two factors that can block the passage from analysis to action are: (1) Complexity of understanding technical aspects of ABC; (2) Defensive behavior induced by embarrassment or threat of having to act on unfamiliar or new information. (Cooper, et al., 1992) To overcome these two factors, a successful activity-based cost management project requires both strong project management skills, for the analysis process, and skills in managing organizational change process if decisions and actions are to be taken. (Cooper, et al.,1992)

To use ABC/ABM to manage an organization costs, it is also important to be knowledgeable of the terminology. ABC/ABM has its own terminology.

1. Terminology

CAM-I is a not-for-profit research consortium of government and private industry that conducts and supports research in cost management. Listed below are terms from CAM-I's *Glossary of Activity-Based Management (1991)* that are important in understanding ABC/ABM.

Activity- Work performed within an organization.

Activity Cost Pool- A grouping of all cost elements associated with an activity.

Activity Driver- A measure of the frequency and intensity of the demands placed on activities by cost objects (e.g., number of machines required for a test).

Activity-based Costing (ABC)- A methodology that measures the cost and performance of activities, resources and cost objects. It recognizes the causal relationships of cost drivers to activities.

Activity-based Management (ABM)- A discipline that focuses on the management of activities as the route to improving the value received by the customer and the profit achieved by providing this value. ABM draws on ABC as its major source of information.

Cost Driver- any factor that causes a change in the cost of an activity.

Cost Element- an amount paid for a resource consumed by an activity.

Cost Object- any customer, product, service, contract, project, or other work unit for which a separate cost measurement is desired.

Cost Pool- A grouping of all cost elements associated with an activity.

Performance Measures- Indicators of the work performed and the results achieved in an activity, process, or organizational unit.

Resource- An economic element that is applied or used in the performance of activities (e.g., salaries, materials).

Resource Driver- A measure of the quantity of resources consumed by an activity (e.g., total square feet of space occupied by an activity). (CAM-I, pg. 1-13, 1991)

2. Different Views of Cost

There are cost accounting systems in place that allocate indirect costs, to products or services, using a direct standard measure (e.g., direct labor costs). Cost information will be accurate only if indirect activities are consumed in direct relation to the direct standard measure, which may not be the case. ABC systems examine how indirect activities are consumed in the process of supplying a product or service. ABM systems examine why indirect costs increase or decrease to understand the causes of these indirect costs.

To illustrate how ABC and ABM can fit into an organization's financial decision support system, Arthur Andersen & Co. identifies three views of cost: financial, operational and strategic. The financial view of cost looks at an organization's overall revenues and expenses. The operational view of cost measures the cost performance of an organization's activities. The strategic view of cost identifies what each activity in an organization actually costs to perform. The focus and uses of each view of cost are detailed in the figures below:

Financial View of Cost: Focus is on Reporting	
Users of Information	*Financial controllers* *Regulatory agencies* *Upper Management*
Uses	*Cost reporting* *Inventory valuation* *Monitoring net operating revenues*
Levels of Aggregation	*High* *Often institution-wide data*
Reporting Frequency	*Periodic, usually monthly* *Probably quarterly or annually*
Types of Measures	*Mostly financial*

Figure 4.1 Financial View of Cost (Arthur Anderson, 1999)

Operational View of Cost: Focus is on Executing	
Users of Information	*Front-line managers* *Process improvement teams* *Quality teams*
Uses	*Key performance information* *Value/non-value added identifiers* *Manage daily activity*
Levels of Aggregation	*Very detailed* *Department/functional level*
Reporting Frequency	*Immediate* *Possibly daily or weekly*
Types of Measures	*Physical*

Figure 4.2 Operational View of Cost (Arthur Andersen, 1999)

Strategic View of Cost: Focus is on Planning	
Users of Information	*Business/strategic planners* *Capital budgeting* *Investment managers*
Uses	*Activity-based product costing* *Contract negotiation* *Life cycle costing*
Levels of Aggregation	*Product/functional aggregation* *Detail based on type of decision*
Reporting Frequency	*As needed* *Special studies*
Types of Measures	*Combination of physical & financial*

Figure 4.3 Strategic View of Cost (From Arthur Andersen, 1999)

Some current cost systems provide the financial view of cost, enabling organizations to provide quarterly/annual financial reports. But they are not likely to provide the detail of activity-based systems. An ABM system provides the operational view of cost, enabling managers to identify key performance information. They can measure whether their activities are being performed within cost parameters. An ABC system provides the strategic view of cost, enabling managers to make investment decisions and accurately cost products. ABC provides a snapshot of what an organization's activities actually cost. (Antos and Brimson, 1994)

Arthur Andersen points out that an activity-based approach is intended to be a tool to successfully achieve and maintain change. Optimally, activity-based information serves as a targeting device for improvement opportunities and provides a cost foundation for performance measurement. (Authur Andersen, 1999) Activity-based information has been identified as an important element to successfully restructuring federal RDT&E organizations. (GAO, 1998)

B. GENERAL ACCOUNTING OFFICE REPORT ON RDT&E

The General Accounting Office (GAO) report titled *Best Practices: Elements Critical to Successfully Reducing Unneeded RDT&E Infrastructure* (GAO, 1998), focuses on identifying the best methods for achieving cost reductions while still maintaining an effective research, development and testing capability in DOD. GAO examined how two organizations (the Boeing Information, Space and Defense Group and the British Defense Research Agency (DRA)) successfully reduced their laboratories' infrastructure and costs. (GAO, 1998)

GAO concluded that one of the elements that was critical to these organizations' successful reductions was the collection of accurate, reliable, and comparable data that captured total infrastructure costs and their utilization rates for each activity. Boeing and DRA both developed standardized data collection instruments that captured necessary details about their infrastructure, which included each laboratory's geographic location, original and current purpose, present and future projects, unique capabilities, product areas, equipment values, utilization rates, maintenance costs, personnel costs and capabilities, anticipated capability requirements and potential consolidation/closing requirements. (GAO, 1998)

GAO contrasted the federal agencies' infrastructure reduction efforts to Boeing and DRA's approaches. GAO concluded that federal agencies, including DOD, were not as successful because they made decisions using various definitions of R&D infrastructure without considering fully the scope of existing infrastructure and lacking information of the cost to operate it and the way to assess its value. GAO did mention that NASA developed a financial system to gather accurate and reliable data about the

true cost of operating RDT&E facilities. GAO did not provide specifics about NASA's new financial management system but they did conclude that even full implementation of this financial system will not provide the level of detailed information necessary for successful infrastructure consolidation. (GAO, 1998)

C. DEFENSE COST MANAGEMENT INITIATIVES

DOD has taken initiatives to improve their cost management systems in their RDT&E and acquisition organizations. Two DOD process improvement programs that contain cost management initiatives are the Laboratory Quality Improvement Program and National Performance Review Goals.

1. Laboratory Quality Improvement Program

The DOD Deputy Director of Research and Engineering (DDR&E) chartered the Laboratory Quality Improvement Program (LQIP) in May 1994 as a tool to improve the quality and productivity of the DOD laboratories. LQIP initiatives are focused on improving the efficiency and productivity of the DOD laboratories by streamlining their business practices in such areas as civilian personnel, financial management, information infrastructure, contracting, and facilities renewal. One specific cost management initiative is for the heads of DOD laboratories to design a financial management approach that will permit the identification and comparison of true costs of doing business at the DOD laboratories and test centers. According to the DDR&E, progress on this initiative has been difficult. (USD A&T, 1999)

2. DOD National Performance Review Acquisition Goals

In response to Vice President Gore's National Performance Review (NPR), DOD has published twelve NPR Acquisition Goals. Goal ten deals with internal acquisition reinvention through better cost management. The goal specifically states:

> Define requirements and establish an implementation plan for a cost accounting system that provides routine visibility into weapon system life-cycle costs through activity based costing and management. The system must deliver timely, integrated data for management purposes to: permit understanding of total weapon costs; provide a basis for estimating costs of future systems; and feed other tools for life cycle cost management. (Acquisition & Business Management (ABM), Goal #10, 1999)

The Service logistic chiefs affirmed the importance of this goal when they gathered at the Program Executive Officers (PEO) Commanders and Program Managers (PM) conference in April 1997. They concluded that the single largest impediment to controlling and managing system Life Cycle Costs (LCC) is the lack of an adequate cost accounting system that provides accurate cost visibility. But the Life Cycle Cost problem will not get fixed quickly because Goal Ten (ABC) has turned out to be very challenging for the Navy to implement. Of the twelve DOD NPR Acquisition goals, it is the goal that is in jeopardy and not on target according to the Navy Executive Director for Acquisition and Business Management assessment in January 1999. (ABM, 1999)

V. CAM-I ABC/ABM MODEL

The CAM-I ABC/ABM model is comprised of two parts: ABC cost assignment view and ABM process view. This thesis is focused on the first part, ABC, but the second part, ABM, is described in this chapter for reference purposes. The scope of this thesis is concerned with logical cost allocation. The ABC cost assignment model goes beyond some current product costing systems, by identifying costs based on cause and effect relationships and providing cost information to management in a financial metric form. (Cokins, Stratton, and Hebling, 1992)

A. CAM-I ABC COST ASSIGNMENT MODEL

The CAM-I ABC Cost Assignment model follows a logical process flow. The model is designed in a flowchart structure and is displayed in Figure 5.1. Starting from the top, resources are consumed by activities that are performed to produce a cost object.

CAM-I ABC Cost Assignment Model

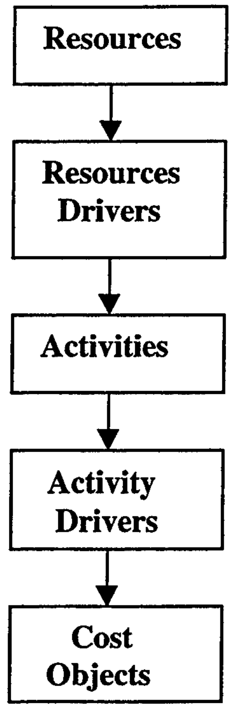

Figure 5.1 CAM-I ABC Model

Resources at the top of the model, are the easiest to define because they are listed in the payroll and expenditure tracking systems. Resources are the factors that are employed to perform an activity. (Antos and Brimson, 1994) Resources represent people, computers, technology, equipment, machines, supplies, tooling, and other inputs.

Resource drivers are how costs are assigned to activities. Resource drivers measure the quantity of resources consumed by an activity (i.e., number of labor hours). It is the method used to associate resource costs with activities. (Arthur Andersen, 1999)

Activities are important elements in the model because they are what consume resources and produce outputs (cost objects). Identification and analysis of a organization's activities determines how they use their resources to achieve their objective.

Activity drivers are how costs are assigned to cost objects based on unique consumption pattern. (Cokins, Stratton, and Hebling,1992) They are a measure of the frequency and quantity of the demand placed on an activity by a cost object (i.e., number of test hours). (Arthur Andersen, 1999)

Cost object at the bottom of the model is an output that a laboratory or organization produces. A cost object is any customer product, process, or project for which a separate cost measure is desired. (Arthur Andersen, 1999) For example, lab management wants to know how much it really costs to develop a software simulation program, therefore the software simulation program would be considered as a cost object.

1. Activity Identification

An activity is what organizations do. Describing an activity should always be done with an active verb and an object. (Antos and Brimson, 1994) An example of this verb object relationship would be: create a program, compile test results and maintain ejection tower. Proper identification of an organization's activities will form the foundation of the activity cost analysis model.

Activities can be classified by what purpose it serves in the organization. Not all activities contribute in the same way to the achievement of the primary mission of the organization. Activities can be classified by the following characteristics:

Primary activities – Activities that contribute directly to the mission of a department or a lab (e.g., design product). A primary activity output is for consumption by an external customer.

Secondary activity – Secondary activities support primary activities (e.g., supervision, training, and secretarial support).

Value Added Activities – Activities that contribute to the value of a product or service, and/or contribute to product attributes and service level paid for by customers (e.g., design product, deliver product)

Non-Value Added Activities – Activities that do not increase the value of a product or service (e.g., chase supplies, repair machines, inventory equipment)

Repetitive Activities – ongoing and continuous in nature (e.g., purchase material, prepare management reports)

Non-Repetitive On-Off Activities – Activities with a precise start and end point (e.g., reorganize lab, install flight simulator) (Antos and Brimson, 1994)

Primary activities can be characterized as providing output for use outside the organization or by another department within the organization. (Antos and Brimson, 1994) Secondary activities are essential for the successful execution of primary activities, but they must be carefully managed because they drain time and resources from primary activities. (Antos and Brimson, 1994) It is also important to identify whether the activity is value adding or non-value adding, because it is useful in determining where to effectively cut costs. (Lewis, 1999) An easy way to identify the difference, between the two, is that a manager would want to optimize value-added activities and minimize non-value-added activities.

2. Activity Analysis

. Activity analysis decomposes a large complex organization into elementary activities that are understandable and easy to manage. The explicit management of activities gives an enterprise a better insight into how resources are employed and whether the activity contributes to the achievement of corporate objectives. (Brimson and

Antos 1994). A laboratory manager that has knowledge of how his or her organization's activities consume resources and produce output can trace costs and effectively measure performance.

If activities are consistently defined, best practice comparisons can be made with another organization's similar activities. Antos and Brimson (1994), recommend a series of steps to conduct a logical and consistent activity analysis, as follows:

a. **Determine activity analysis scope**

b. **Determine activity analysis units**

c. **Define activities**

d. **Rationalize activities**

e. **Classify activities as primary or secondary**

f. **Create activity map**

g. **Finalize and document activities** (Antos and Brimson, 1994)

These steps are a framework for an activity analysis; they should, however, be tailored to meet the specific needs of an organization. (Antos and Brimson, 1994) An explanation of each step is provided:

a. Determine activity analysis scope

Activity analysis should start with a pilot program that covers only a segment of the organization. (Antos and Brimson, 1994) It is important to collect background information about the segment of the organization, such as organization charts, office layout graphs, and list of capital equipment, previous activity information, job descriptions and information flow charts.

b. Determine Activity Analysis Units

An organization chart and head count summary provides a starting point because they help ensure the structure of the organization is understood and that the whole organization is covered. (Antos and Brimson, 1994) If a lab is so small that only one person does a variety of activities, then that person would be the analysis unit. For example, if only one person lubricates, replaces components and troubleshoots the laboratory's equipment, it would be considered just one activity, "equipment maintenance".

c. Define Activities

Defining activities is accomplished by selecting an activity approach, determine activity definition criteria, and deciding on data collection techniques. (Antos and Brimson, 1994)

1. Activity Approach – A decision must be made whether to use a business process or functional approach depending on the desired purpose of the study, and the resources and time available. The business process approach traces inputs to output in a sequential manner, where the output of one activity will become the input for another. The functional approach breaks down a function (e.g., research) into activities. (Antos and Brimson, 1994)
2. Determining Activity Definition Criteria – There are several rules of thumb for determining whether a definition of an activity is sufficient: 1. An activity must have a discernable and homogeneous output; 2.

Activities must represent a significant level of expenditure; and 3. Keep it simple. (Antos and Brimson, 1994)

3. Data Collection Techniques – In selecting the appropriate data collection technique, the two key criteria to consider are the degree of precision and the cost of measurement. The primary techniques include interview, observation, self-analysis and activity sampling. (Antos and Brimson, 1994)

d. Rationalize Activities

A key to meaningful activity definition is to structure an activity list that provides a sufficient, but not excessive, level of detail. The more simplified the activity list, the easier it is to manage and positively influence business decisions. (Antos and Brimson, 1994) For example, if an organization develops a list of 50 activities, it should then redefine them as tasks and group them into 10-12 significant activities. (Antos and Brimson, 1994) Activities are comprised of many tasks. For example, the activity of cleaning your car is made up of tasks such as washing the car, cleaning the windows and vacuuming the interior.

e. Classify Activity as Primary or Secondary

Each activity should be classified as primary, one whose output is used outside an organizational unit, or as secondary. Secondary activities are used within a department to support the primary activities. Activity classification is necessary to apportion the cost of secondary activities to the primary activities for service and product costing. Also the classification provides a means to monitor the ratio of secondary activities to primary activities. (Antos and Brimson, 1994)

f. Create Activity Map

An activity map identifies the relationship between activities and an organization's mission or function by visually representing how activities are tied to the organization's output. The activity map shows the organization's activities and describes the cost structure in terms of activity consumption. (Antos and Brimson, 1994) Figure 5.2 is an example of an activity map.

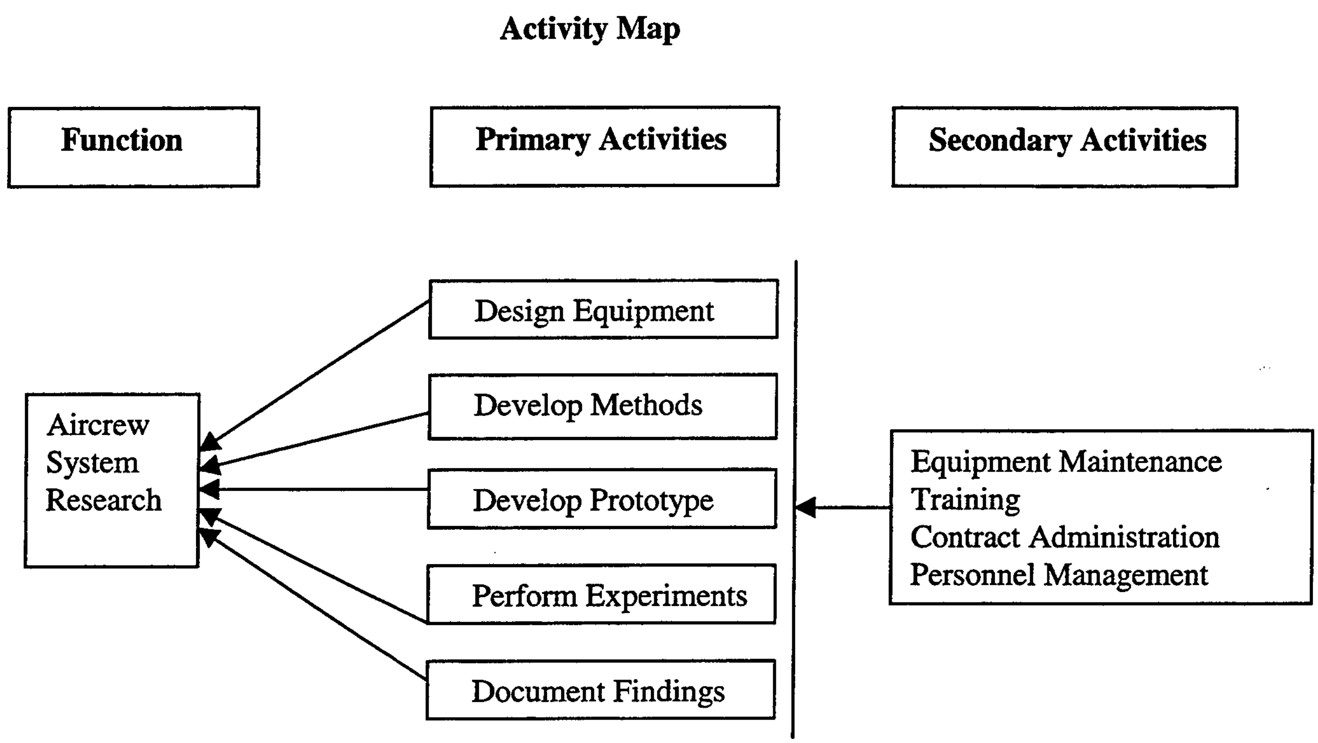

Figure 5.2 Activity Map Example

g. *Finalize and Document Activities*

The final step is to compile a composite list of activities that supports the organizational objectives and functional analysis requirements. (Antos and Brimson, 1994)

B. CAM-I ABM PROCESS VIEW MODEL

The CAM-I ABM process view model enhances a manager's ability to manage an organization by highlighting areas for process improvement. The process view provides a means to evaluate how an operational cost driver causes activities to use more or less resources when performing work and yielding an output, as depicted in Figure 5.3.

CAM-I ABM Process View Model

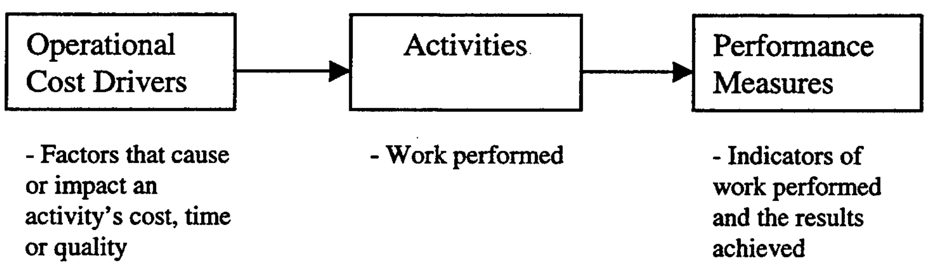

Figure 5.3 CAM-I ABM Process Model

The application of the ABM model can only be done after the ABC model has been applied. The ABM model will use the information provided by the ABC model and provide a different analysis.

> Concentrating on the cost assignment view increases product cost accuracy, which in turn leads to better strategic decisions for pricing, product mix, resource allocation and product design. ABM provides

> activity-based information to focus employee efforts on continuously improving quality, time, service, cost, flexibility, and profitability. The process view provides an operational and tactical tool to improve performance. (Cokins, Stratton, Hebling, pg. 25, 1992)

Part of an effective ABM analysis is a well conducted cost driver analysis. Cost driver analysis identifies factors that influence the cost and performance of an organization's activities. (Antos and Brimson,1994) Also, performance measures must be identified to provide a perspective on how effective the activities are at achieving the organization's objectives. (Antos and Brimson, 1994)

1. Operational Cost Driver

In simple terms, an operation cost driver is the root cause of why an activity becomes more or less expensive. Examples of cost drivers are government regulations, unanticipated delays, product/service complexity and inadequately trained personnel. Activities will usually have multiple operational cost drivers, but the focus should be on identifying the most prominent cost driver that can be controlled. (Arthur Andersen, 1999) Making the cost driver more efficient can then enable process improvement.

2. Performance Measures

Performance measures must be chosen to answer the question, "How well are we doing?" Performance measures are evaluative criteria to determine efficiency, effectiveness, and utility. (Cokins, Stratton, Hebling, 1992) These measures must be balanced among quality, cost and time, or there will be an overemphasis on only one performance aspect. Examples of performance measures are: 1. (Time) What percent of aircraft structure designs on-schedule? 2. (Quality) How many times does a test need to be rerun? 3. (Cost) What is the cost per test?

Remember that the CAM-I ABC/ABM model is not just a financial tool. Activity-based information adds the element of cost to other initiatives, such as process reengineering and capacity utilization measurement, and should provide clarity and measurable results.

VI. ADAPTING THE CAM-I ABC MODEL TO THE LABORATORY

The CAM-I ABC model provides the basic framework for conducting activity analysis. The author interviewed ABC experts, NAWCAD senior management in competency 4.0 (Research and Engineering), and NAWCAD division supervisors in both competency 4.0 (Research and Engineering) and 5.0 (Test and Evaluation) in order to develop a methodology for adapting the CAM-I ABC model to the RDT&E laboratory environment at NAWCAD.

The RDT&E environment is constantly changing with new technology and requirements. Applying ABC to RDT&E activities can be difficult in comparison to more stable manufacturing and service organizations. (Strand, 1999) At least three issues need to be considered when conducting an ABC analysis of RDT&E activities: 1. Is the product or service identifiable? 2. Is there a describable process? 3. Are you trying to hit a moving target? (Strand, 1999)

A. ABC MODEL ADAPTATION

The process flow is traced by beginning with the cost object and ends with resources. Starting with the cost object and working back to the resources provides a clear identification of a laboratory's products and services. Then trace costs from the resources to the cost object, as pictured in Figure 6.1.

CAM-I Cost Assignment Model

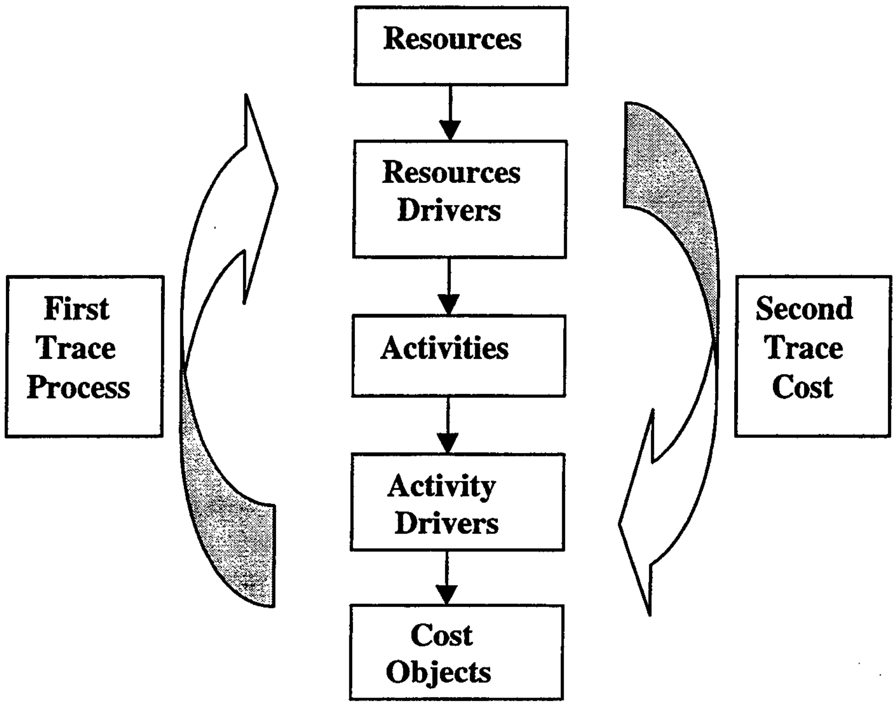

Figure 6.1 ABC Cost Assignment Model
(Source: Adapted from CAM-I ABC Model)

Using the ABC model, the author developed a nine-step methodology for a RSA laboratory manager to use to more accurately identify his or her laboratory's primary activity and secondary activity costs and use them to calculate stabilized RSA rates:

1. ***Identify time frame***
2. ***Identify cost objects***
3. ***Identify activities consumed by cost objects***
4. ***Identify resources consumed by activities***
5. ***Trace costs***
6. ***Compile a list of activities and their activity driver costs***

7. Total activity costs

8. Allocate secondary activity and overhead costs to primary activities

9. Calculate rates

These steps have been designed to be user friendly and not require extensive training in ABC. Discussion of these steps will provide additional insight into effective analysis of the cause of costs.

1. Identify Time Frame

There must be a predetermined time frame established to standardize the collection of cost information. Typical time frames are a month, quarter and fiscal year. It is important that the time frame is long enough to factor out any unusual or short-term fluctuations.

2. Identify Cost Objects

Cost objects are the products and services that a laboratory produces. A comprehensive list of cost objects can be compiled by simply asking, "what do we produce for our customers?"

3. Identify Activities Consumed by Cost Object

Identify the activities that are necessary to produce the laboratory's cost objects, including secondary activities that support the execution of primary activities. A list of possible RDT&E activities taken from Antos and Brimson (1994) and supplemented by two division supervisors (Gondolf, 1999, Harris, 1999) is listed in Figure 6.2.

List of Possible RDT&E Activities	
Build/design equipment	Perform equipment upkeep
Support/visit customers	Provide professional training
Document/communicate findings	Support quality assurance
Performing experiments and tests	Perform routine analysis
Process engineering	Solicit/gather information
Design/plan/prepare for experiments	Attend meetings
Handling materials	Support regulatory requirements
Investigate materials or ingredients	Investigate competitive products
Analyze/investigate data	Troubleshooting
Perform housekeeping	Administer department
Plan/monitor/control projects	Perform data call #
Prepare materials/product	Provide tours #
Develop a prototype	Inventory equipment #
Develop methods	Financial tracking #
Write computer code	Contract development #

Figure 6.2 RDT&E Activities (Antos and Brimson, 1994) (Activities added by division supervisors denoted by #)

An activity driver (unit measure) must be assigned to each activity to quantify how much of the activity was consumed by the cost object. Figure 6.3 is a representation of this identification process. The cost object is the acceleration test program of an aircraft seat, and three activities were identified to execute the test program. The activities are consumed by the cost object in the pattern described by each activity driver (i.e., number of tests).

Identifying Activities to a Cost Objects

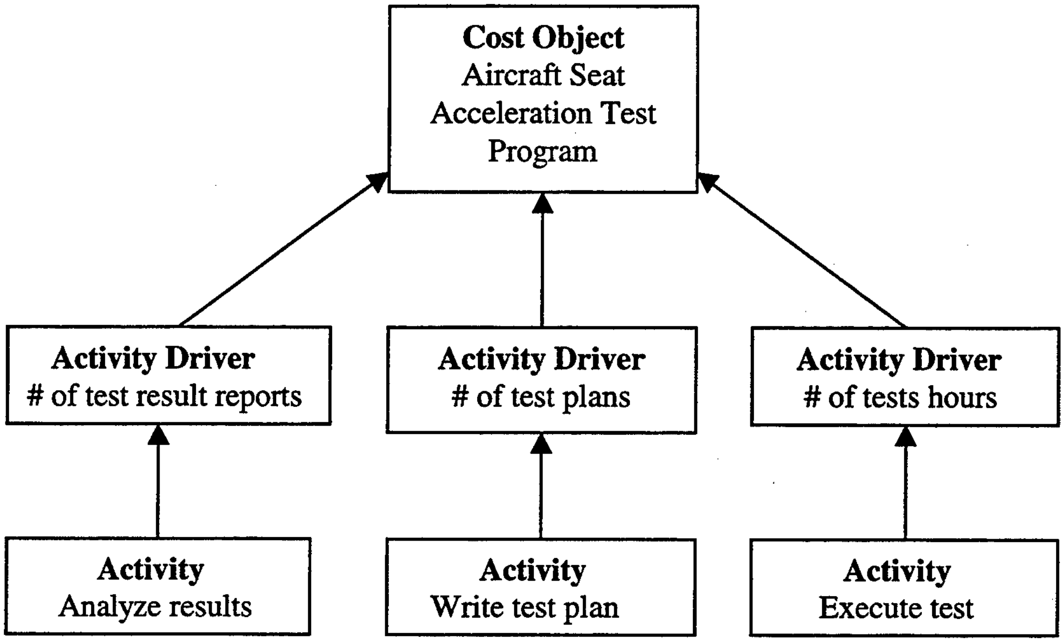

Figure 6.3 Identify Activities to Cost Object Example

4. Identify Resources Consumed by Activities

The person that performs the activity is the expert in identifying the resources that go into the performance of an activity. Resources could be the labor, equipment, and materials located in the laboratory. Resources also could be the production overhead and G&A used when performing or to support laboratory activities such as utilities, hazardous waste disposal and computer resources. A resource driver (unit of measure) must be assigned to each resource to quantify how much of the resource was consumed by the activity. Figure 6.4 is a representation of this identification process. There are three resources that are consumed in the activity of performing a test. The resources are

consumed by the activity in the pattern described by each resource driver (e.g., number of seats shots).

Identifying Resources to an Activity

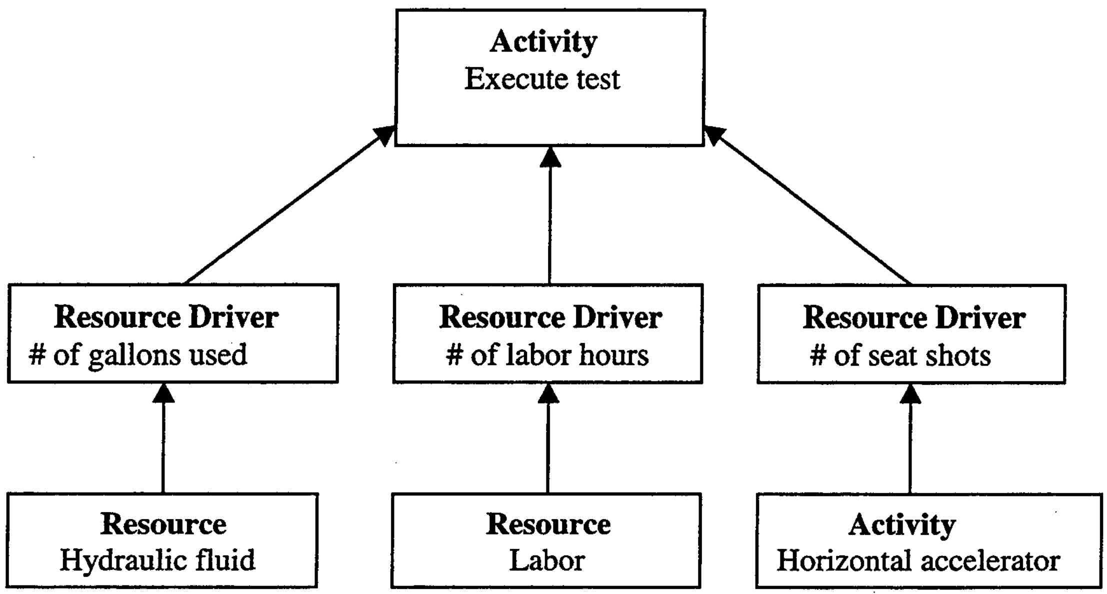

Figure 6.4 Identifying Resources to an Activity Example

5. Tracing Costs

Tracing costs begins with the assignment of costs to the resource drivers and activity drivers determined in steps three and four. A resource driver or activity driver cost can be calculated by dividing the total cost of the resource or activity by the total number of resource or activity drivers units used during the given timeframe. An example of an activity driver unit cost is the average cost per test plan. Examples of resource driver unit costs are the average cost per technician labor hour or the average cost per gallon of hydraulic fluid. When costs are assigned to the resource and the

resources are identified with activities, the cost of a cost object can be traced from the resources. An example of a cost tracing is pictured in Figure 6.5.

Cost Tracing

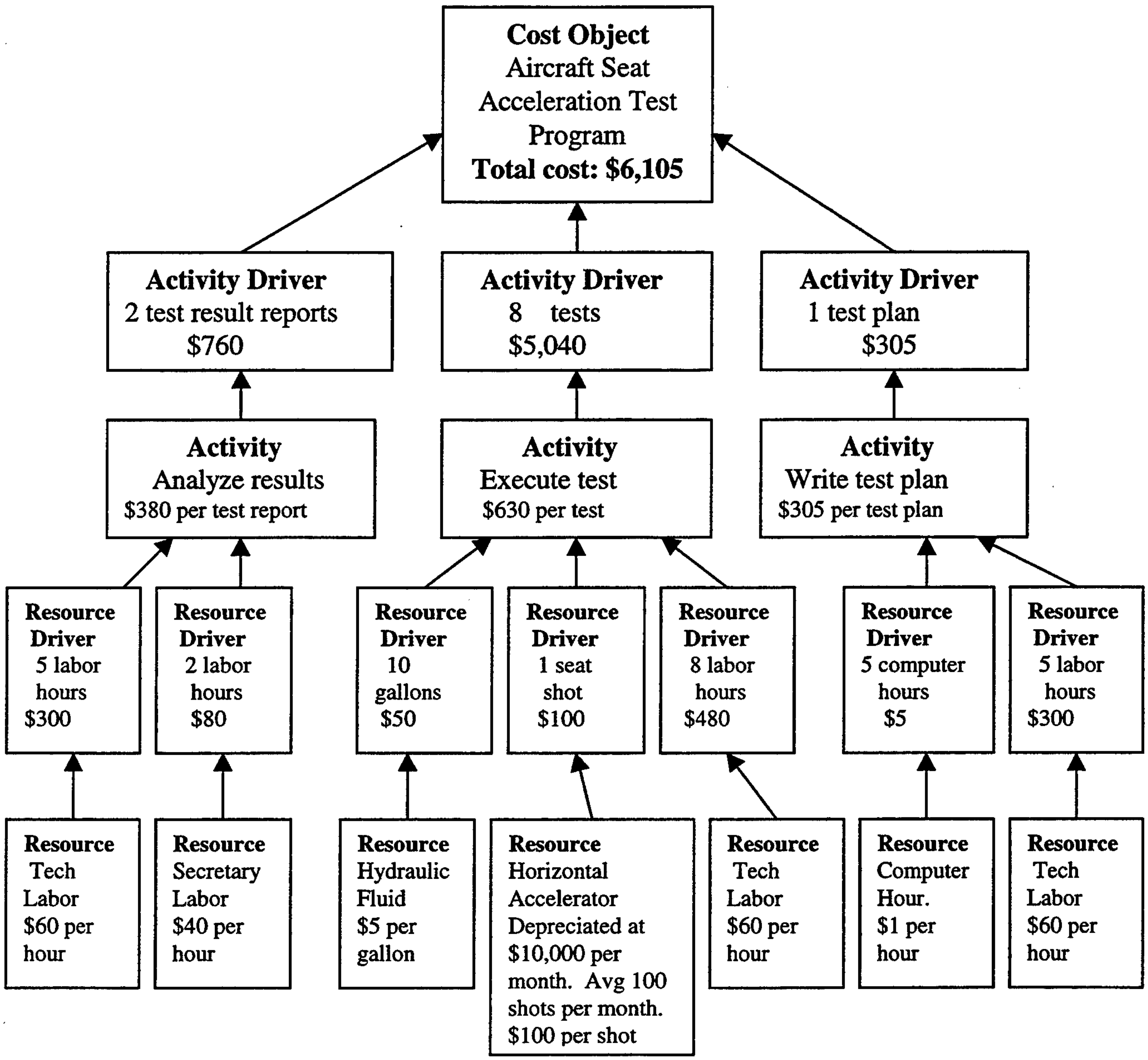

Figure 6.5 Cost Tracing Example

The cost tracing example identifies the cost of each resource and then traces the resource cost to the activity that consumed it using the number of resource drivers units

consumed. For example, each execute test activity consumed ten gallons of hydraulic fluid, one seat shot on the horizontal accelerator machine, and eight technician labor hours. The execute test activity costs are then traced to the cost object using the number of tests used (eight).

6. Compile a List of Activities and Their Activity Driver Unit Costs

After identifying the activities and tracing the cost of activities required to produce all of the laboratory's cost objects, the RSA laboratory will be able to produce a comprehensive list of its activities and their activity driver unit costs. In order to make activity management manageable the list of activities for a specific laboratory should be reduced to under 15 activities, each with its own activity driver unit cost. (Lewis, 1999)

7. Total Activity Costs

To determine what the total fiscal year cost for each activity, an estimate must be made about the total amount of activity driver units, for each activity, that would be performed during the fiscal year. One of the ways the estimate could be accomplished is by having the laboratory employees keep a log of how many activity driver units, for each activity, they perform during a given time period. Another way to estimate total fiscal year activity costs is to have the labaratory employees estimate how much of their time is spent performing each activity. Someone knowledgeable about the laboratory's predicted workload for the upcoming fiscal year (e.g., the laboratory manager) would need to validate the estimates of the activitiy driver units predicted for the year. Once the total amount of activity driver units has been estimated for the fiscal year, the total fiscal year costs for the RSA can be broken down into cost by activity for the laboratory manager.

The ABC total cost view for a RSA laboratory, will look very different then the current cost accounting system used at NAWCAD, as seen in Figure 6.6.

NAWCAD View

Direct Cost	$50,000
Production Overhead	$20,000
G & A	$30,000

ABC View
Costs by Activities

Plan	$10,000
Design	$20,000
Test	$30,000
Analyze	$10,000
Maintain	$15,000
Supervise	$15,000

Figure 6.6 Different Views of Cost

The RSA expenses are identified by activity with the ABC model versus direct costs, production overhead costs, and G&A expenses with the current NAWCAD cost accounting system.

8. Allocate Secondary Activity and Overhead Costs to Primary Activities

Secondary activities costs — those which cannot be tied directly to cost objects — and any overhead expenses that were not traced in previous steps should be allocated to the laboratory's primary activities based on cause and effect. An example of a secondary activity cost and overhead expense allocation is pictured in Figure 6.7.

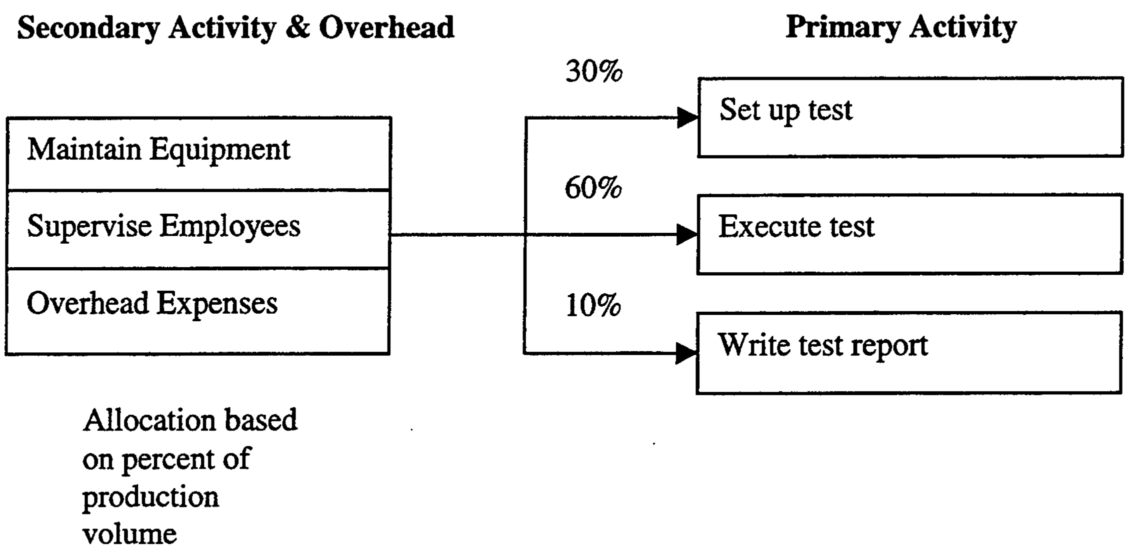

Figure 6.7 Secondary Activity Cost and Overhead Expense Allocation Example

The two secondary activity costs (i.e., maintain equipment and supervise employees) and the overhead expenses have been allocated based on the amount of time the laboratory is used for each primary activity during the identified time frame. The allocation base chosen for this example may not capture the cause and effect relationships as well as some alternative base. For example, the maintenance of equipment probably does not contribute to the primary activity of writing a test report. One challenge in designing the system is to identify causal relationships to allocate secondary activity costs and overhead expenses to primary activities.

9. Calculate Rates

After step eight, all secondary activity and overhead costs have been allocated to the primary activities. Stabilized RSA rates for each activity can now be calculated by dividing the total fiscal year costs for each primary activity by the number of estimated activity driver units, for each primary activity, that will be used for the fiscal year. An example of a RSA rate calculation for a test execution activity is:

Total Fiscal Year Costs for Test Execution		Total Fiscal Year Test Execution Hours		Stabilized RSA Rate per Test Execution Hour
\$100,000	/	10,000	=	\$100 per test execution hour

The rest of the RSA laboratory's primary activities would be put through the same calculation to identify their stabilized RSA rate. The laboratory manager will now be able to bill customers based on the amount of primary activity drivers that went into producing the customer's product or service. The next chapter is a demonstration of applying the ABC model, using the nine-step methodology to a RSA laboratory in competency 4.0 research and engineering.

VII. APPLYING THE ABC MODEL

To apply the ABC model, a survey (See Appendix A for the survey form) was sent to a sample of engineers and technicians in the Electrical Systems Laboratory (ESL), in department 4.4 Propulsion and Power Systems. The ESL was chosen to apply the ABC model because ESL personnel have attempted to improve the way they identify the costs of producing their products and services. The ESL has developed a cost estimation worksheet, pictured in Figure 7.1, which is used to more accurately price their products and services.

Cost Estimation Worksheet			
PRETEST ACTIVITIES SETUP			
Labor:	**Man-hours**	**Man-hour Rate**	**Sub-total**
Civil Service Engineering	1	$ 80.12	$ 80.12
Civil Service Technician	1	$ 67.00	$ 67.00
Contractor Engineering	1	$ 46.00	$ 46.00
Contractor Technician	1	$ 46.00	$ 46.00
Total Labor	4		$ 239.12
Overhead		25%	$ 59.78
Total Labor (w/Overhead)			$ 298.90
Equipmental Rates:	**Equipment Days**	**Equipment Rate/Day**	**Sub-total**
Salt fog/Spray Chamber	1	$ 200.00	$ 200.00
Dust Chamber	1	$ 400.00	$ 400.00
Humidity/Fungus Chamber	1	$ 100.00	$ 100.00
50 HP DS/ Kimbal Fixture	1	$ 100.00	$ 100.00
Temp/Alt Walkin Chamber	1	$ 1,000.00	$ 1,000.00
Temp/Alt/Humid Chamber	1	$ 320.00	$ 320.00
Thermal Shock Chamber	1	$ 320.00	$ 320.00
Blowing Rain Chamber	1	$ 200.00	$ 200.00
U. D. Vibration	1	$ 400.00	$ 400.00
Vibration+Temp/Humidity	1	$ 480.00	$ 480.00
Drivestand	1	$ 320.00	$ 320.00
All Attitude Gearbox	1	$ 320.00	$ 320.00
Instrumentation Van	1	$ 100.00	$ 100.00
Total Equipment Rental Cost			$ 4,260.00
Material Cost:			$10.00
Customer Charge			**$4,568.90**

Figure 7.1 ESL Cost Estimation Worksheet (Gatto and Gilkerson, 1999)

They ESL has developed costs for specific laboratory activities. For example, the daily rate for a temperature/altitude chamber ($1,000), shown in Figure 7.1, is ten times greater than the humidity/fungus chamber ($100). The rate differential is based on the cost for the test equipment, the number of auxilary equipment required, and the number of personnel required to run the test. (Gondolf, 1999)

A. ABC SURVEY

The ABC surveys were mailed to the division supervisor and forwarded to the laboratory manager for distribution to a sample of ESL personnel. The laboratory manager passed the surveys out to the laboratory employees with a brief oral explanation of what type of activity and resource data the author was seeking. Please note that the ABC data results should not be considered as a totally accurate description of the ESL's expenses because resource data costs were estimated. For instance, production overhead and G&A resource costs are not readily available to laboratory personnel.

Out of a total of 20 personnel in the ESL, the survey was given to three civil service engineers, seven civil service technicians and two contractors. The survey asked the laboratory employees to write down all the activities and resources required to produce one of their products or services (cost objects). They were then asked to fill in the estimated cost for each activity and resource. The survey also asked the engineers and technicians to list the activities they perform in a typical work month, and break it down by the percentage of time they spend performing each activity. The survey data results were then compiled and presented as an aggregate activity representation of the ESL. Only one of the actual cost object analyses will be modeled to display an individual activity and resource evaluation.

1. ABC Survey Results

The survey results are presented in the order of the ABC model nine-step methodology described in Chapter Six. Some of the step results are combined in the survey.

a. Identify Time Frame

Because this was a sample ABC survey, the respondents were requested to identify activities and resources that produce only one cost object, therefore a specific time frame was not required to be identified for the cost object analysis. The respondents were asked to list all the activities they perform in a typical month. Then they were asked to estimate what percent of their time, during a typical month, is spent doing each activity.

b. Identify Cost Object

The survey asked the laboratory employees to identify the most prominent product or service that they provide for their customers. Out of the twelve surveys returned to the author, nine different cost objects were identified by the engineers and technicians. The nine cost objects identified are listed in Table 7.1.

1. AH1 Starter (Helicopter Starter) Test
2. 28 Volts Direct Current (VDC) Endurance Test
3. Helicopter Seat Test
4. F/A 18 E/F Generator Endurance Test
5. F/A 18 E/F Generator Reliability Development Test
6. F/A 18 C/D Generator Control Unit Test
7. Unmanned Air Vehicle (UAV) Electrical Power System Test
8. Life Raft Dust Test
9. Transformer Rectifier Test

Table 7.1. Electrical Systems Laboratory Sample List of Cost Objects

All nine cost objects relate to the performance of some type of test.

c. *Identify Activities Consumed by Cost Objects, Identify Resources Consumed by Activities, and Trace Costs*

The respondents were asked to start with a cost object (product/service) and think of every activity and resource required to produce the cost object. They were asked to pay particular attention to production overhead and G&A. The respondents estimated resource cost data and the quantity of the resources used for each activity. The respondents also identified the amount of activity time required for each activity in order to produce the cost object. The predominant resource identified in all the surveys was either a engineer or technician labor hour. To provide an example of an activity and resource analysis for a cost object, the author modeled the data and traced the costs that an engineer provided for a F/A-18 E/F Generator Reliability Development Test Program, pictured in Figure 7.2.

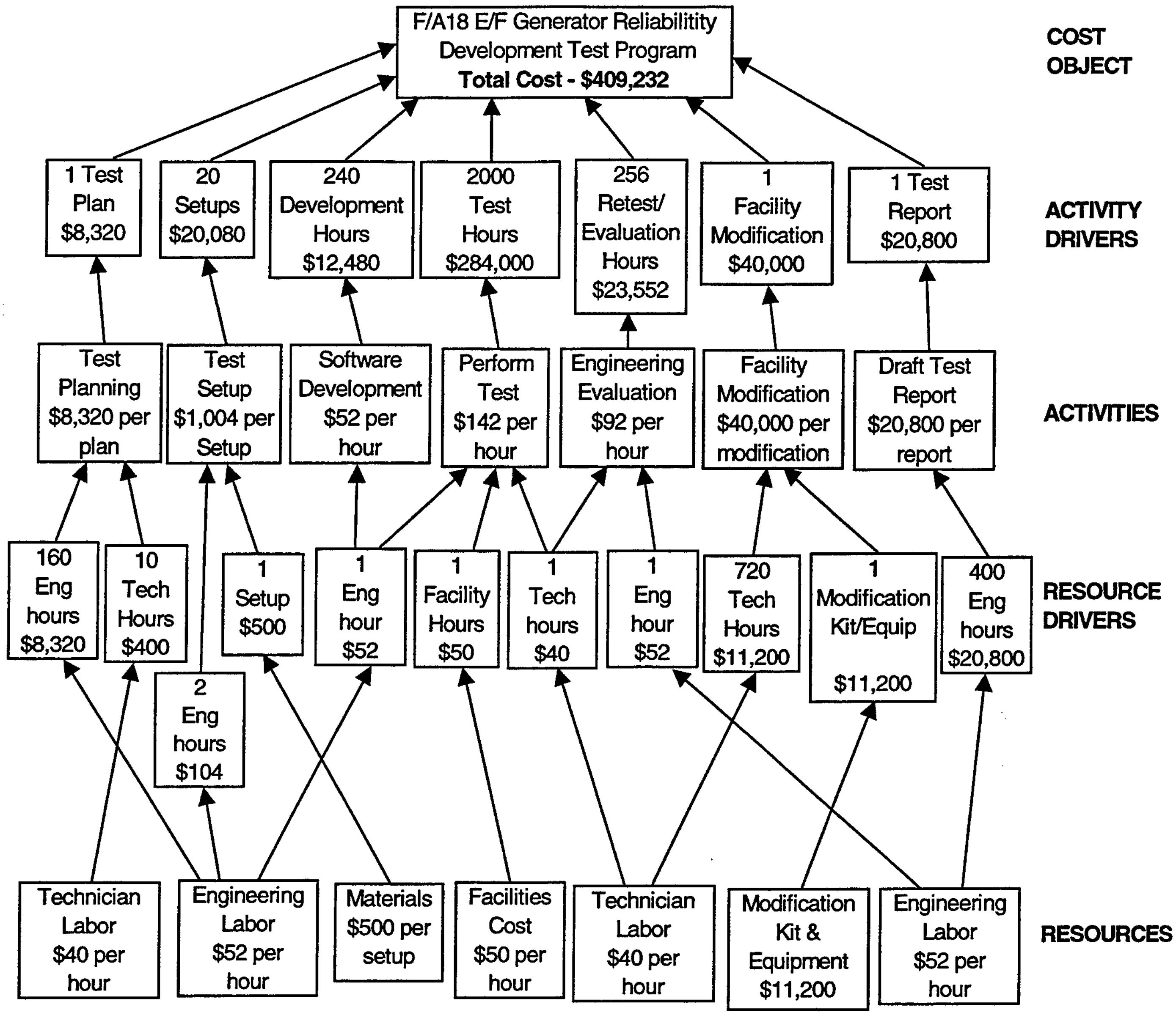

Figure 7.2 ABC Analysis of F/A-18 Generator Reliability Development Test Program

The engineer identified seven different activities that use five different resources. Six of the activities are repetive. One activity, modifying the laboratory's facility to meet the requirements of the test program, would be considered a non-repetitive activity.

d. Compile a List of Activities and Their Activity Driver Units

The author compiled a list of activities identified with the survey and grouped them into the twelve most prominent activities. The result was that ESL's normal activities include seven primary and five secondary activities. The list of activities for the ESL presented in Table 7.2. Next to each activity is its activity driver unit and cost per activity driver unit.

Primary Activities	**Activity Driver Unit**	**Cost Per Unit**
Plan Test	Plan Hour	$44
Perform Test	Test Hour	$160
Test Setup/ Breakdown	Setup Hour	$60
Design/Build Equipment	Design Hour	$54
Draft Test Report/ Proposal	Draft Hour	$42
Attend Meetings	Meeting Hour	$40
Engineering Research	Engineering Hour	$55
Secondary Activities		
Equipment Maintenance/Repair	Maint Hour	$49
Install Equipment/ Modification	Install Hour	$49
Training	Hour	$40
Admin/Data Call	Hour	$40
Inventorying Equip	Hour	$40

Table 7.2. List of Electrical Service Laboratory Activities
1. Attending a meeting is a primary activity that provides a service for a customer

The appropriate activity driver unit for each activity was determined by the respondent's description of how each activity was consumed by the cost object. The activity cost per unit was calculated by averaging the activity cost per unit that all twelve respondents provided on their survey responses. The most expensive activity is test

performance because it consumes the most resources per hour such as test equipment, hazardous material, and two or more personnel working at the same time (concurrent labor).

e. Total Activity Costs

In order to identify the total cost for each activity, an estimate had to be made of how many activity driver units per activity would be used in a year. The respondents were asked to estimate what percent of their time is spent doing each of their activities, in a typical month. The percentages were used to calculate the total amount of each activity's activity driver units that would be performed in the fiscal year. The average time reported by all twelve laboratory employees is pictured in the pie chart in Figure 7.3.

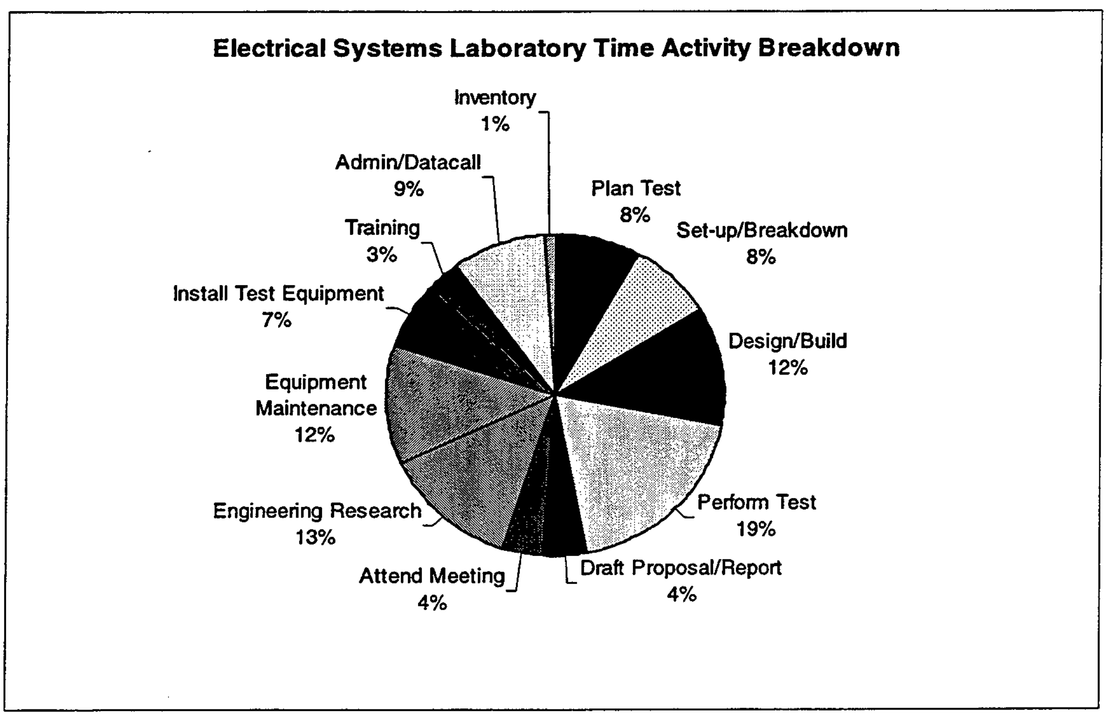

Figure 7.3 Electrical Systems Laboratory Activity Breakdown

The largest percentage of the ESL's time is spent performing actual tests (19 percent). Other activities that had a percentage greater than 10 percent were engineering research (13 percent), design and build equipment (12 percent) and perform equipment maintenance (12 percent). Two activities that could be classified as non-value adding actitivities are inventorying equipment and administrative/data call activities. They do not add value to the products and services provided to the customers of the ESL. They take up 10 percent of ESL's time.

The total estimated amount of fiscal year activity driver units per activity is listed in Table 7.3. This activity cost estimate is based on the employees' views of future demand based on past experience. For the purposes of this example these data are sufficient to demonstrate how to apply the model. However, if the model is to be used in a laboratory an estimate of demand for the laboratory services should be used to validate and if necessary adjust the number of total activity driver units.

Primary Activities	Unit of Measure	Cost Per Unit	# of units in FY
Plan Test	Plan Hour	$44	1850
Perform Test	Test Hour	$160	4396
Test Setup/ Breakdown	Setup Hour	$60	1850
Design/Build Equipment	Design Hour	$54	2776
Draft Test Report/ Proposal	Draft Hour	$42	925
Attend Meetings	Meeting Hour	$40	925
Engineering Research	Engineering Hour	$55	3008
Secondary Activities			
Equipment Maintenance/Repair	Maint Hour	$49	2776
Install Equipment/ Modification	Install Hour	$49	1619
Training	Hour	$40	694
Admin/Data Call	Hour	$40	2082
Inventorying Equip	Hour	$40	231

Table 7.3 List of Electrical Service Laboratory Total Activity Driver Units

Under the current NAWCAD financial accounting system, the ESL's costs are separated into direct expenses, production overhead expenses, and G&A expenses. By comparison, the ABC model breaks down the ESL's total expenses into activity costs and a smaller overhead allocation. The ABC model activity costs were determined by multiplying the cost for each activity unit by the estimated total activity driver units that would to be used for the fiscal year based on the employees estimated demand, as listed previously in Table 7.3. The comparison of the different views of costs between the NAWCAD financial accounting system and the ABC model is pictured in Figure 7.4.

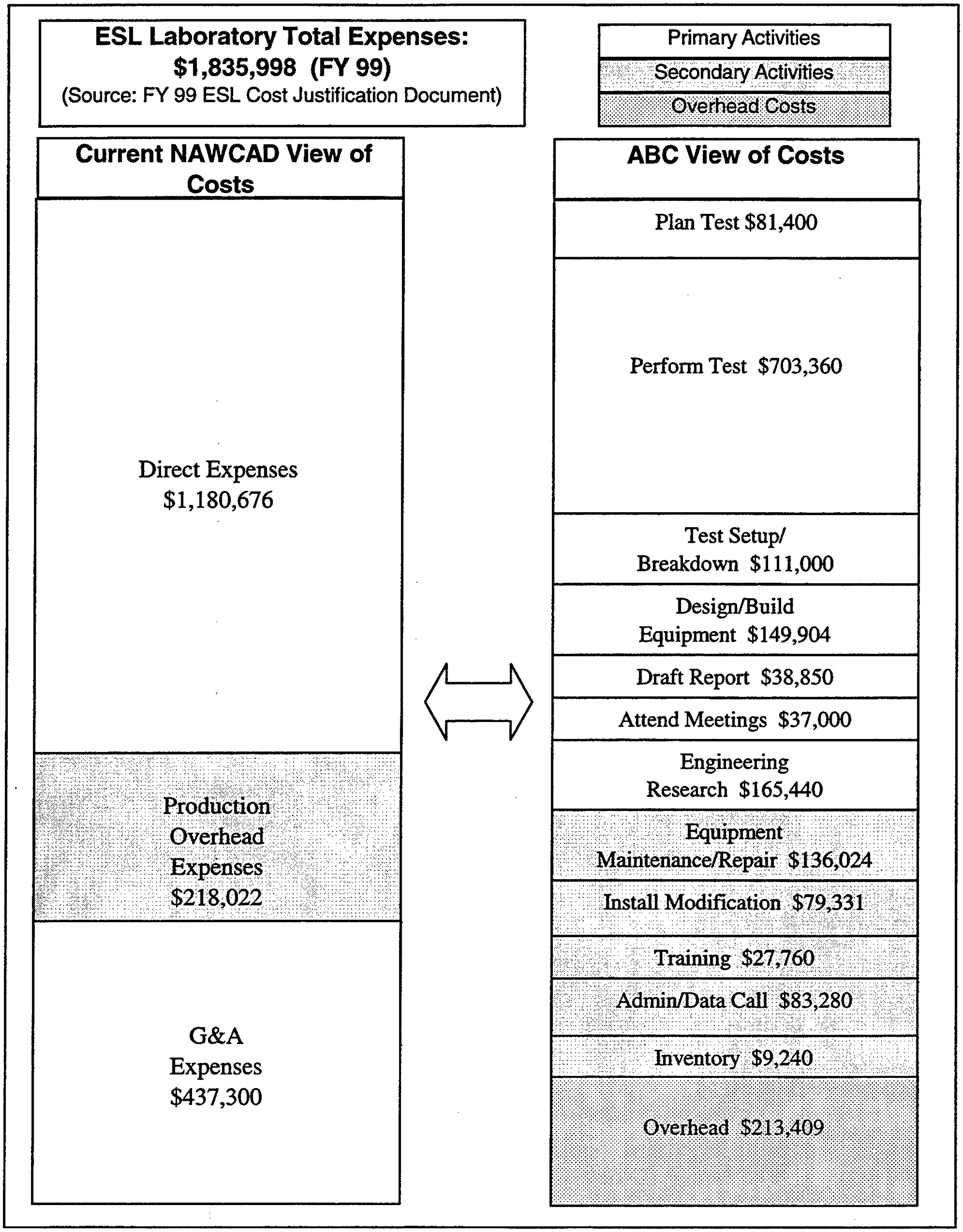

Figure 7.4 ESL Different Views of Cost

The ABC model identified the total costs for the primary activities as $1,286,954 and for the secondary activities as $335,635. That left $213,409 of untraceable costs, which were labeled as overhead. The ABC model assigns the laboratory's costs to activities that a laboratory manager can recognize and use to improve performance. An estimated activity cost breakdown by percentage of total RSA laboratory costs is pictured in Figure 7.5.

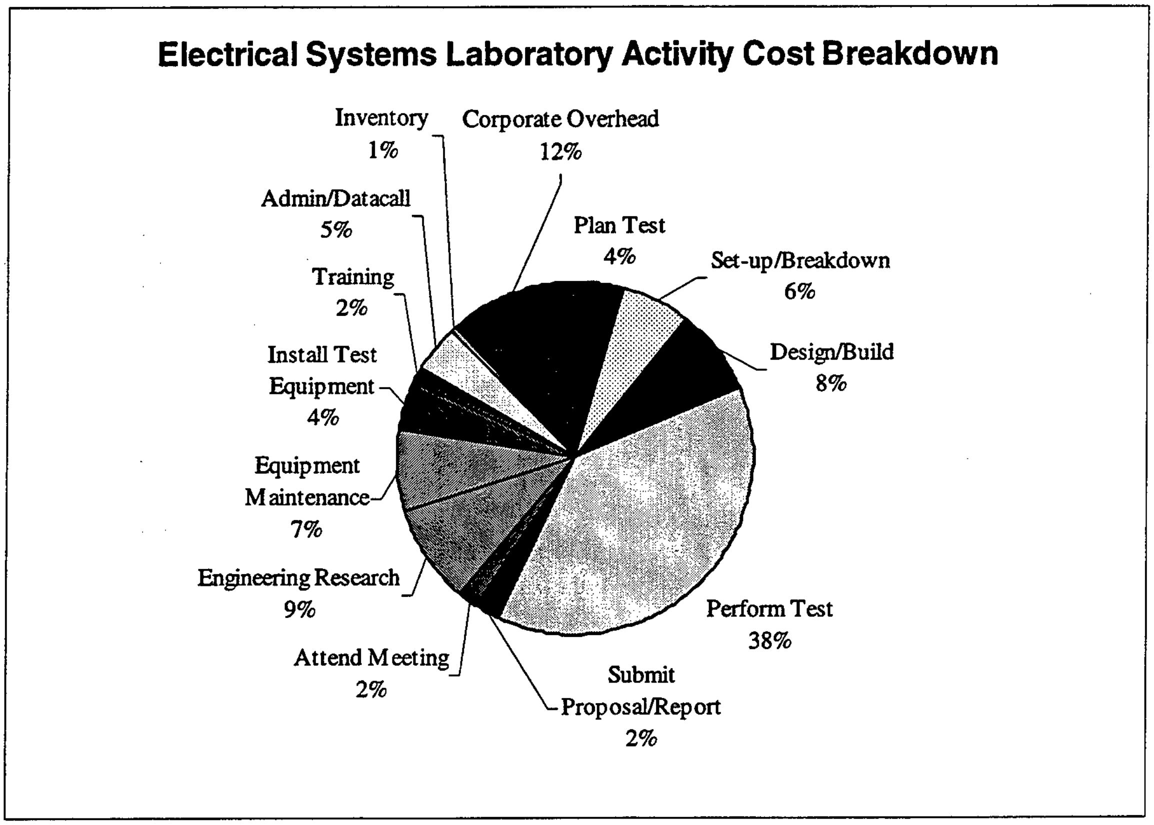

Figure 7.5 Electrical Systems Laboratory Activity Cost Breakdown

In general, the activity cost percentages for activities are different than their amount of activity time percentages. Figure 7.5 emphasizes that the activity of actual test performance comprises the largest percentage, 38 percent, of ESL's total expenses. But in comparison, the ESL spends only 19 percent of their time performing

tests. The non-value adding activities, inventorying and administrative/data call, consume five percent of ESL's total expenses.

f. Allocate Secondary Activity and Overhead Costs to Primary Activities

For this example, the ESL laboratory's secondary activity and overhead expenses ($549,044) were allocated to the primary activities using the ratio of the cost of each primary activity to the total cost of all primary activities. The amount of secondary activity and overhead expenses allocated is 30 percent of ESL's total costs therefore, the laboratory might determine a way to distribute these expenses to the primary activities based on better cause and effect relationships. The percentage breakdown for the ESL primary activities is illustrated in Figure 7.6.

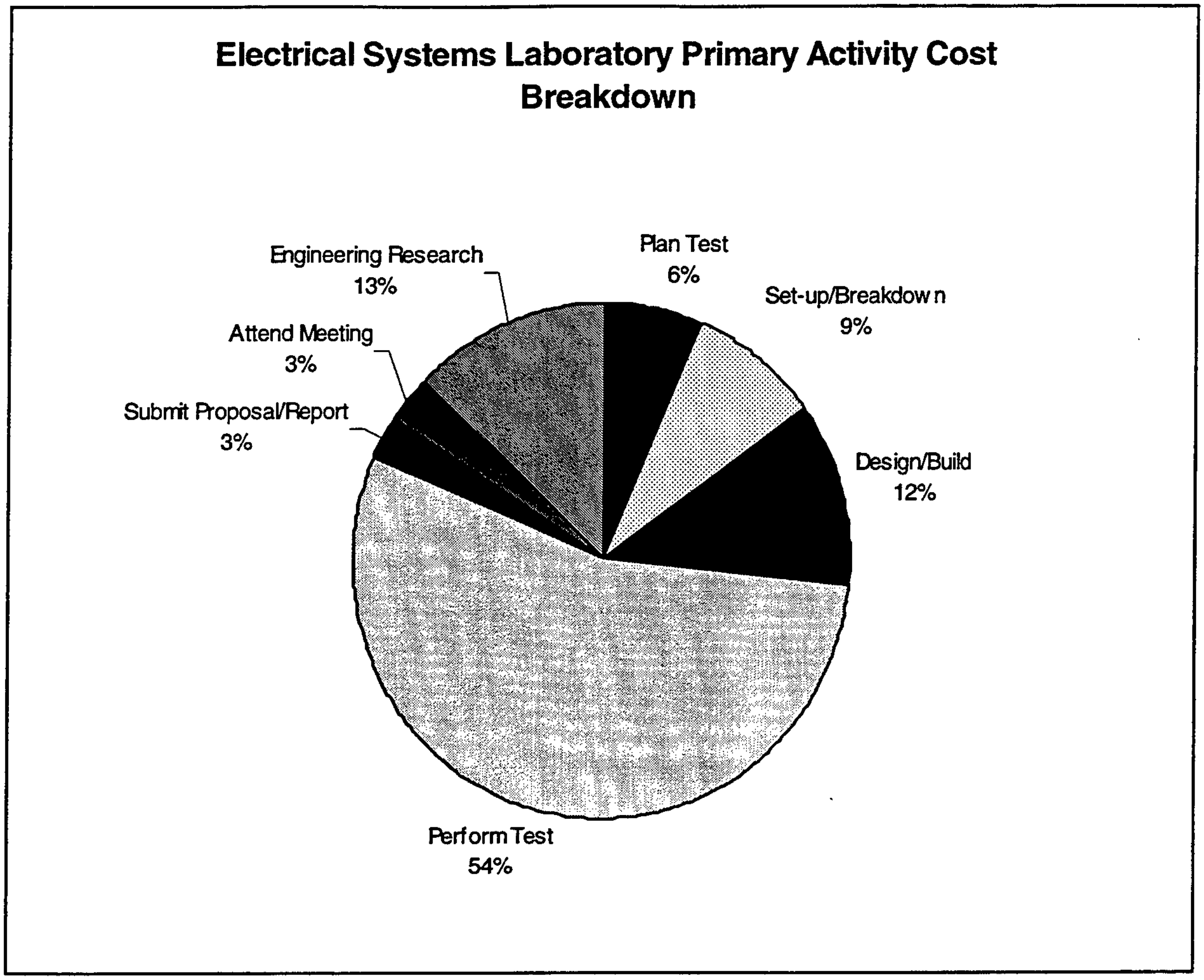

Figure 7.6 Percentage Breakdown of ESL Primary Activity Costs

The majority of the $549,044 of secondary activity and overhead costs were allocated to the primary activity of perform a test. The balance of the secondary activity and overhead cost allocations to other primary activities are listed in Table 7.4.

Primary Activities	Total Secondary and Overhead Cost Allocation
Plan Test	$32,943
Perform Test	$296,484
Test Setup/ Breakdown	$49,414
Design/Build Equipment	$65,885
Draft Test Report/ Proposal	$16,471
Attend Meetings	$16,471
Engineering Research	$71,376

Table 7.4 ESL Secondary Activity and Overhead Cost Allocation

g. *Calculate Rates*

To determine the stabilized RSA rates, the secondary and overhead expense allocations were added to the primary activity costs for each activity. The RSA rates were then calculated by dividing the total cost of each primary activity by the number of activity driver units that would be performed during the fiscal year. The resulting stabilized RSA rates are shown in Table 7.5.

Primary Activity	Primary Activity Cost	Allocated Costs	Total Cost	# of Activity Driver Units	RSA Rate
Plan Test	$81,400	$32,943	$114,343	1850	$61.81 per hour
Perform Test	$703,360	$296,484	$999,844	4396	$227.44 per hour
Test Setup/ Breakdown	$111,000	$49,414	$160,414	1850	$86.71 per hour
Design/Build Equipment	$149,904	$65,885	$215,789	2776	$77.73 per hour
Draft Test Report/ Proposal	$38,850	$16,471	$55,321	925	$59.81 per hour
Attend Meetings	$37,000	$16,471	$53,471	925	$57.81 per hour
Engineering Research	$165,440	$71,376	$236,816	3008	$78.73 per hour
Total	$ 1,286,954	$549,044	$1,835,998		

Table 7.5 ESL Stable RSA Primary Activity Rates

VIII. DISCUSSION

A. IMPLEMENTING THE MODEL

Four factors to be considered if the ABC model was implemented at NAWCAD laboratories. The factors are based on, discussions with the ESL management while the survey was being filled out by the ESL employees and on the author's review of the survey data results. The four factors are:

1. *Time is a major factor* – The degree of desired activity cost data precision will drive the time required to collect the activity and resource cost data. The more precise the ABC data required the more time must be invested to the ABC study. An in-depth ABC study could take approximately one to two months of onsite observation by someone knowledgeable with ABC analysis principles. (Roberts, 1999)

2. *Training is required* – An important element to getting the best and most honest activity and resource data from personnel is to provide them quality training at the beginning of the ABC analysis. Because of time constraints, formal training was not provided to the employees whom responded to the survey. The only instruction that the author provided was a one-page memo at the beginning of the survey. Training provides a knowledge base that an employee can use when identifying activities and resources.

3. *G&A resource costs are difficult to identify* – The ESL does not pay directly for the G&A resources they use. They are allocated a share of the overall NAWCAD G&A expenses through a G&A assessment (G&A tax) to their RSA, based on direct work years. Therefore, the laboratory employees cannot readily identify the actual cost of the G&A resources that they use.

4. *Commitment from management is essential* – An important element for effectively implementing the ABC model at a NAWCAD laboratory, is commitment from the laboratory, division, department, competency and corporate management. The informative survey results from the ESL respondents were the direct result of the support from the division manager and the laboratory manager. Typically, when personnel are faced with the requirement to conduct an ABC analysis they will prioritize its importance by how much emphasis management places on it. (Lewis, 1999)

B. ABC MODEL EFFECTIVENESS

The ABC model enabled the sampled ESL laboratory employees to identify sufficient cost and time information about the activities they perform and resources they use to breakdown their laboratory into twelve activities and their associated costs. The ABC model survey results provide the ESL information that identifies what activities are consuming the bulk of the laboratory resources.

The simplicity of the ABC model makes it understandable for the laboratory employee to use without being an accountant. As mentioned in the lessons learned, the

majority of respondents were able to provide a comprehensive activity and resource analysis without any formal training. The concepts used by the ABC model are based on common sense and are effective for analyzing the laboratory's business processes. The ABC model puts costs into terms of activities that consume resources, as compared to the current NAWCAD financial accounting system that describes cost in terms of direct labor, production overhead and G&A expenses.

1. Calculate Stabilized RSA Rates with ABC Model

The manager of a RSA laboratory can use the ABC model to develop stabilized RSA rates. The ABC model was effective for developing an example of seven stabilized RSA rates for the ESL. During the fiscal year's budget execution, the customer will be billed using the seven stabilized rates based on their consumption of all the primary activity driver units. One consideration is that seven stabilized RSA rates might not be sufficient to accurately identify resource cost usage for the ESL. They have a variety of test equipment that can be used when performing a test and each has a predetermined daily cost. The list of the ESL's test equipment and their daily rate is presented in Table 8.1.

Test Equipment	Equipment Rate/Day
Instrumentation Van	$100
Humidity/Fungus Chamber	$100
50 HP DS/ Kimbal Fixture	$100
Blowing Rain Chamber	$200
Salt fog/Spray Chamber	$200
Temp/Alt/Humid Chamber	$320
Thermal Shock Chamber	$320
Drivestand	$320
All Attitude Gearbox	$320
Dust Chamber	$400
U. D. Vibration	$400
Vibration+Temp/Humidity	$480
Temp/Alt Walkin Chamber	$1,000

Table 8.1 List Of ESL Test Equipment Daily Rates
(Source: ESL Cost Estimation Worksheet, Gatto & Gilkerson, 1999)

The ESL might want to break down the test performance activity rate into six separate stabilized RSA rates that are based on the daily costs of the type of equipment used for the test. Two examples are the temperature/altitude chamber at $1,000 per day and the dust chamber at $400 per day. The ESL would then have twelve stabilized RSA rates that reflect how products/services consume resources.

C. ABC MODEL BENEFITS

1. Resource Management

The last decade of reduced defense spending, especially in RDT&E, has forced laboratory managers to make decisions on where they can reduce resource costs. With the ABC model, the manager has resource costs defined by activities and can make

informed resource reduction decisions. For example, if the ESL needed to reduce costs, the managers of the laboratory could investigate reducing the amount of resources that are consumed by the activity of performing a test, because it consumes 38 percent of the laboratory's resource expenses. Alternativly, the ESL might determine that more of the laboratory's resource expenses should be used for test performance, and that the amount of resource costs going towards a secondary activity such as administration and data call should be reduced.

2. Customer Product/Service Pricing

Using the ABC model to establish stabilized RSA rates for the year will help ensure that customers are billed for products and services at a more accurate rate than under the current NAWCAD Direct Labor Hour (DLH) rate system. The development of a cost estimation worksheet (Figure 7.1) by the ESL laboratory highlights the need for laboratories to accurately identify resource costs incurred when providing a product/service to their customer. Billing customers based on consumption of activity costs, matches resource costs to the customer that actually consumes the resources.

Also, the ABC model translates customer charges into terms that the customer can understand, such as hours to plan test, hours to design equipment, hours spent in integrated program team meetings. The laboratory can justify costs of products/services to their customers when their rates are explained in terms of activity costs rather than direct labor, production overhead and G&A expenses.

3. Process Improvement

The ABC model provides the activity cost information that is an essential element to measuring performance and ultimately improving a laboratory's processes. The information goes beyond describing the total cost to operate a specific laboratory, it identifies the cost of the activities performed in the laboratory. This model can be used to benchmark a laboratory's activities against the best practices of NAWCAD, DOD, federal or commercial laboratories that perform similar activities.

D. MAKING THE ABC MODEL MORE EFFECTIVE

The ABC model can be made more effective by more accurately identifying G&A resource costs that are consumed by the RDT&E laboratories at NAWCAD. The lack of actual G&A resource cost information was an obstacle to conducting an effective ABC analysis.

G&A expenses make up 24 percent of the ESL laboratory's total expenses for the fiscal year. Laboratory employees cannot control the G&A expense by decreasing or increasing their consumption of G&A resources such as, utilities, capital investments (depreciation), hazardous material handling, and computer support. The current NAWCAD financial system of allocating G&A resource costs does not have a built-in incentive for laboratory personnel to optimize and efficiently use these G&A resources. The resource costs are not presented to the laboratories in terms of how they consume them. A laboratory manager that wants to reduce costs and optimize his resources will focus on the costs he or she can control. (Strand, 1999)

An effective way, to improve identification of laboratory resource cost data and build an incentive for the efficient use of G&A resources, is to apply the ABC model at

the G&A activities that produce the G&A resources for NAWCAD's internal customers. The G&A resources could be budgeted for and consumed by laboratories, or any internal customer, based on stabilized rates like the external customers of an RSA laboratory. If G&A resource providers distribute their products/services in the form of rate per unit consumed, they will increase resource cost visibility and build stronger customer/provider relationships in the NAWCAD organization. The implementation of the ABC model at NAWCAD's G&A resource provider activities is in keeping with their funding purpose, because increased cost visibility and stronger customer/provider relationships are major tenets of the NWCF.

IX CONCLUSONS & RECOMMEDATIONS

A. CONCLUSIONS & RECOMMENDATIONS

An ABC model was adapted to a NAWCAD laboratory. The required expertise needed to implement an ABC model at a laboratory is located right in the laboratory. The laboratory managers, engineers, technicians and support staffs are very knowledgeable about what activities go into providing products and services for their external customers. To maximize the benefits of the adapted ABC model requires a commitment to: allotting enough time to conduct the study, quality training prior to conducting the analysis, and commitment from management to achieve the objectives of the ABC study. The benefits of more accurate activity and resource cost information should make applying the adapted ABC model, at a NAWCAD RSA laboratory, worthwhile. The remainder of this section is an elaboration of more specific conclusions that resulted from this thesis.

1. Application of the Adapted ABC Model is Effective and User Friendly

The adaptation of the CAM-I ABC model can be effectively applied to a NAWCAD RSA laboratory by following the nine-step methodology that was explained in Chapter VI:

1. *Identify time frame*
2. *Identify cost objects*
3. *Identify activities consumed by cost objects*
4. *Identify resources consumed by activities*
5. *Trace costs*

6. *Compile a list of activities and their activity driver costs*

7. *Total activity costs*

8. *Allocate secondary activity and overhead costs to primary activities*

9. *Calculate rates*

Using these nine steps to apply the CAM-I ABC model makes it user friendly for the laboratory personnel to identify the laboratory's activities and the resources used. In the case of the Electrical Systems Laboratory (ESL), the sample of engineers and technicians was able to identify seven primary and five secondary activities that make up their laboratory's processes, and they identified the resources that were consumed by those activities.

Recommendation: If NAWCAD decides to integrate ABC at their laboratories, the adaptation of the CAM-I ABC model should be used as the initial ABC template. The factors discussed in the previous chapter should be taken into consideration when applying the adapted ABC model.

2. ABC Model Provides Activity Cost Management Information

The current NAWCAD financial accounting system provides basic cost management information that a laboratory manager can use to manage his or her laboratory's activities and resources. Laboratory expenses are classified as direct costs, production overhead costs, and G&A expenses. The NAWCAD accounting system does not provide laboratory activity cost information and the associated resource costs. The adapted ABC model improves the information regarding what laboratory activities are used in the production and support of the laboratory's products and services. It also identifies the resource costs that were accumulated in the performance of each activity.

Recommendation: The activity cost information should be used to more accurately price products and services for external customers.

3. ABC Model Enhances the Calculation of Stabilized RSA Rates

The Rated Service Account (RSA) laboratories calculate stabilized rates by dividing the laboratory's direct expenses and overhead expense allocation by a logical unit measure or measures (e.g., planning hours, setup hours, and execution hours). These logical units of measure are generally activities. The ABC model defines more activities to develop RSA rates and more accurately identifies what amount of resource costs should be associated with each primary activity driver unit rate. The ABC model converted ESL's one RSA rate, based on engineering hours, to seven different primary activity unit rates that each varied in price depending on the cost per hour to perform the activity.

Recommendation: The RSA is currently set up to collect and recover resource costs with a stabilized rate that reflects the consumption of resources. The ABC model provides a method to identify stabilized RSA rates that accurately capture the resource consumption pattern. The author recommends that NAWCAD conduct a fiscal year pilot study at one laboratory, using the adapted ABC model to develop rates and bill customers.

4. ABC Model Cost Data Supports Laboratory Restructuring and Process Improvement

The adapted ABC model provides activity cost information that supports NAWCAD's laboratories efforts to the become leaner and more efficient under the guidelines of SECDEF' *Vision 21: The Plan for 21st Century Laboratories and Test and Evaluation Center of the Department of Defense.* The adapted ABC model identifies

what the cost of activities and highlights how laboratory activities will be affected by planned resource reductions. Additionally, identification of a laboratory's activity costs can be used to benchmark that laboratory against the best practices of another laboratory that performs similar activities.

Recommendation: NAWCAD efforts to establish laboratory performance metrics and process improvement initiatives should use ABC data as the cost input. The activity cost data, resulting from the adapted ABC model, will provide the level of detail necessary to perform accurate performance measurements and benchmarking against similar laboratories.

5. G&A Resource Costs are Difficult to Identify

G&A resource costs are difficult for laboratory personnel to identify because they are presented to them as a G&A rate allocation or "G&A tax".

Recommendation: In order to provide accurate G&A resource cost information to laboratory managers, ABC studies could be conducted at NAWCAD's G&A activities. NAWCAD has already conducted an ABC study at the information management department (G&A activity). However, the results are not available because they are being used for an outsourcing competition. (Strand, 1999) The identification of actual G&A resource costs will enhance the application of the ABC model at the laboratory level.

B. SUGGESTED FURTHER STUDIES

Based on observations made while conducting research for this thesis, the author suggests the following topics for further study:

1. The RSA laboratory is set up to collect and recover resource costs with a stabilized rate or rates that are based on a logical unit of measure that attempts to match

actual resource consumption. In contrast, non-RSA laboratories recover direct and overhead expenses by billing customers with stabilized rates based on direct labor hours. What are the benefits and drawbacks to converting more NAWCAD laboratories to the use of RSAs for cost recovery?

2. The burdened rate disparity, at NAWCAD, is the difference between the overhead cost burden shouldered by government personnel (NAWCAD civilian and military employees) and civilian contractors. What are the advantages and disadvantages of applying NAWCAD overhead expenses at a different rate to government employees and commercial contractors? What effect does this disparity of overhead allocation actually have on the hiring of government employees and contractors?

3. Competency 5.0's, test and evaluation, overhead expenses are paid through appropriated Major Range Test Facility Base (MRTFB) funding. MRTFB is appropriated funding that is intended to fund national test and evaluation assets that are deemed essential to national defense and are considered a national asset. Are there any NAWCAD competency 4.0, research and engineering, RDT&E laboratories that should receive appropriated funding because they are unique and should be considered as a national asset?

4. The "Death Spiral" is a term used to describe the effect that a shrinking customer base has on increasing the stabilized rates for the rest of the customer base. NWCF budgets are based on a forecast of an upcoming fiscal year's workload. If the workload does not materialize, there will be fewer customers and less direct labor work years available to be used to allocate overhead expenses. Has a "Death Spiral" actually affected NAWCAD's stabilized rates and the size of their customer base?

APPENDIX A. ABC SURVEY

Thank you for taking the time to fill out this survey. The data will be used to support thesis work I am conducting as a graduate student at the Naval Postgraduate School in Monterey, CA. I am interested in identifying the activities that are necessary to produce products/services for one of your customers (i.e. NAVAIR), at a typical lab at NAWCAD. I also would like to identify the most critical resources needed to perform these activities.

I need your help to gather this information. Please identify the most prominent product/service you provide to your customers. Then I would like you to list the activities that are required to generate this product/service on the Process form I have provided. The form is designed so that each page will capture the product or service and the related activities. I have attached a sample list of possible RDT&E activities on the back of this survey. Do not limit yourself to just these activities. I would like you to limit the total number of activities per product/service to the eight most important. Do not feel obligated to list eight activities if the product/service requires fewer activities. For each activity, please circle the word direct if the activity directly occurs in the production of the product/service, or circle the word support if the activity supports the production of the product/service (i.e. cost estimation, equipment maintenance). For each activity, note the duration (how long it takes), and list what you think causes or drives the activity to increase or decrease.

I would also like you to list the four most critical resources that go into the performance of each activity. Give your best estimate of the total quantity of the resource used and its total cost. When listing labor as a resource, list the number of employees involved in parentheses and list the combined total labor hours of all employees. When determining resources, please identify as many production overhead and G&A resources as possible.

I have enclosed an example Process Sheet as a guide. I listed five activities that I thought would be necessary in order to complete an aircraft generator durability test. The information is hypothetical and not based on fact. Four of the activities are directly related to the actual test, and the fifth activity (test equipment maintenance) is a support activity that is required to ensure that the test stand is available when a customer needs a durability test. Limit support activities to anything that occurred within 30 days of the product/service completion. For the resources I listed, I made sure I included the total quantity used and total cost of the resource consumed. When calculating total labor cost, I multiplied total man-hours used with the average hourly wage (I estimated at $60 per labor hour). If I listed tools or equipment as a resource, I listed an estimate of the total cost of the set of tools or equipment. If there was not an appropriate answer for total quantity used or total cost of a resource (i.e. lab space), then I put a question mark.

Finally, please fill out the Time Ratio Questionnaire with your best estimate of how you spend your time during the month. Do not worry about being 100% accurate, I just want you to use your judgement and give your best estimate as you fill out this survey. Please return your completed surveys to Mr. Joe Gandolf.

Thanks once again for your help,

LCDR Bob Stailey

Please enter following data:

Pay Plan(GS/Contractor)	Grade	Step	Position Title	Primary Workspace
(example) *GS*	*11*	*8*	*Electronic Tech*	*Lab 2-34*

Example

Total Cost

Process Form — Product/Service #1 *A/C Generator Durability Test*

Activity: *Plan Test*
Direct or Support (Circle One) — Duration: *6.0 hrs*
Cause or Driver: *# of test specifications*
Resources: #1 *Labor (1)* — Tot Qty: *6.0 hr* Cost: *$240*
#2 *Computer Resources* — Tot Qty: *4.0 hr* Cost: *?*
#3 — Tot Qty: Cost:
#4 — Tot Qty: Cost:

Activity: *Set-up & Breakdown*
Direct or Support (Circle One) — Duration: *4.5 hrs*
Cause or Driver: Size of generator
Resources: #1 *Labor (3)* — Tot Qty: *13.5 hr* Cost: *$800*
#2 *Engine Oil* — Tot Qty: *5 gal* Cost: *$5*
#3 *Hydraulic lift* — Tot Qty: *.5 hr* Cost: *$5*
#4 *Shop tools* — Tot Qty: Cost: *$1000*

Activity: *Periodic test stand maintenance*
Direct or Support (Circle One) — Duration: *6 hrs per month*
Cause or Driver: *Durability of equipment*
Resources: #1 *Labor (1)* — Tot Qty: *6.0 hr* Cost: *$240*
#2 *Consumables* — Tot Qty: Cost: *$50*
#3 *Hazmat* — Tot Qty: Cost: *$40*
#4 *Shop tools* — Tot Qty: Cost: *$1000*

Activity:
Direct or Support (Circle One) — Duration:
Cause or Driver:
Resources: #1 — Tot Qty: Cost:

Activity: *Inspect generator*
Direct or Support (Circle One) — Duration: *2.0 hrs*
Cause or Driver: *Size of generator*
Resources: #1 *Labor (1)* — Tot Qty: *2.0 hr* Cost: *$120*
#2 *Shop tools* — Tot Qty: Cost: *$1000*
#3 — Tot Qty: Cost:
#4 — Tot Qty: Cost:

Activity: *Run Test*
Direct or Support (Circle One) — Duration: *24 hrs*
Cause or Driver: *Length of test*
Resources: #1 *Labor (2)* — Tot Qty: *24 hr* Cost: *$1460*
#2 *MA-2 Test Stand* — Tot Qty: *24 hr* Cost: *$60,000*
#3 *Electricity* — Tot Qty: *24 hr* Cost: *$20*
#4 *Lab space # 2-4* — Tot Qty: *24 hr* Cost: *?*

Activity:
Direct or Support (Circle One) — Duration:
Cause or Driver:
Resources: #1 — Tot Qty: Cost:
#2 — Tot Qty: Cost:
#3 — Tot Qty: Cost:
#4 — Tot Qty: Cost:

Activity:
Direct or Support (Circle One) — Duration:
Cause or Driver:
Resources: #1 — Tot Qty: Cost:

Process Form **Product/Service:**

Activity:
Direct or Support (Circle One) Duration:
Cause or Driver:
Resources: #1 Tot Qty: Cost:
#2 Tot Qty: Cost:
#3 Tot Qty: Cost:
#4 Tot Qty: Cost:

Activity:
Direct or Support (Circle One) Duration:
Cause or Driver:
Resources: #1 Tot Qty: Cost:
#2 Tot Qty: Cost:
#3 Tot Qty: Cost:
#4 Tot Qty: Cost:

Activity:
Direct or Support (Circle One) Duration:
Cause or Driver:
Resources: #1 Tot Qty: Cost:
#2 Tot Qty: Cost:
#3 Tot Qty: Cost:
#4 Tot Qty: Cost:

Activity:
Direct or Support (Circle One) Duration:
Cause or Driver:
Resources: #1 Tot Qty: Cost:
#2 Tot Qty: Cost:
#3 Tot Qty: Cost:

Activity:
Direct or Support (Circle One) Duration:
Cause or Driver:
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Activity:
Direct or Support (Circle One) Duration:
Cause or Driver:
Resources: #1 Tot Qty: Cost:
#2 Tot Qty: Cost:
#3 Tot Qty: Cost:
#4 Tot Qty: Cost:

Activity:
Direct or Support (Circle One) Duration:
Cause or Driver:
Resources: #1 Tot Qty: Cost:
#2 Tot Qty: Cost:
#3 Tot Qty: Cost:

Time Ratio Questionnaire

In a typical month (160 working hours), what activities do you perform? What percentage of your month is spent doing those activities? (The total sum of all activity percentages should not exceed 100%)

Direct Product/Service Activities
(Activities directly performed to produce a product/service)

List activities below:

________________ / ____ %
________________ / ____ %
________________ / ____ %
________________ / ____ %
________________ / ____ %
________________ / ____ %
________________ / ____ %
________________ / ____ %
Other ________________ / ____ %

Can you suggest a way to increase the efficiency of any one of these activities? ________________

Support Activities
(Activity that can't be directly tied to a product/service's production process)
List activities below:

Training ________________ / ____ %
Inventory ________________ / ____ %
Data Call ________________ / ____ %
Equipment Maintenance ________________ / ____ %
________________ / ____ %
________________ / ____ %
________________ / ____ %
________________ / ____ %
Other ________________ / ____ %

Can you suggest a way to increase the efficiency of any one of these activities? ________________

List of possible activities:

1. Build/design equipment or instrumentation.
2. Support/visit customers.
3. Document/communicate findings.
4. Performing experiments and tests.
5. Process engineering.
6. Design/plan/prepare for experiments.
7. Handling materials.
8. Investigate materials or ingredients.
9. Analyze/investigate data.
10. Perform housekeeping.
11. Plan/monitor/control projects.
12. Prepare materials/product.
13. Develop a prototype.
14. Develop methods.
15. Write computer code.
16. Perform equipment upkeep.
17. Provide professional training.
18. Support quality assurance.
19. Perform routine analysis.
20. Solicit/gather information.
21. Attend meetings.
22. Support regulatory requirements.
23. Investigate competitive products.
24. Troubleshooting.
25. Administer department.

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